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Editorial

CLEAN MILK.

THE question of the supply of Clean Milk to the Public appears to afford greater difficulties to those who are outside the ring of intimate knowledge than we have any conception of. It begins with the cow and ends with the consumer, but during its passage from one to the other, catches many snags. In the cow itself, there is the question of health, and tuberculosis looms far and wide on the horizon. One hears again and again the statement made that there are practically a million tuberculous cows in Great Britain, and that as only a comparatively small proportion of these have tuberculosis of the udder, it is admitted that the question of eradication is not only one of cost, but also one of expediency. At the same time there is no one bold enough to say that they should not be firmly taken in hand and put under legal control. America has, in this respect, given us a lead, and there are now large areas and large herds where the system of radical eradication has been practised and tuberculosis of the dairy cattle has become non-existent. What has been done in America can be done in Great Britain, and once tuberculosis has been stamped out our insular position ought to make it comparatively easy to keep our herds free.

At the present moment the surroundings of the cow form the second great problem, and there is no other food product which would be allowed to be sold daily as a food for infants and invalids, which is in many places collected under such unnecessarily filthy conditions. Cowsheds and dairies, and the milking cows themselves, ought to be under proper veterinary supervision and inspection. At present there are many hundreds of milking sheds in which the Inspector appointed by the Ministry of Health (usually a medical man) has never set his foot ; and it is not far from the mark, too, to say that the Official Inspector, even if he tries to perform his duties properly, has no practical knowledge of what he is supposed to inspect. Such inspection is, obviously, the job of the veterinarian, and it seems such a peculiar anomaly that in 1927 we still find such duties being attempted to be performed by the Medical Officer of Health or the Sanitary Inspector.

To put the inspection of milk from the cow to the consumer on a satisfactory basis, from the " clean milk " point of view, the Inspection Board, to be complete, should have one of each—a Medical, and a Veterinary, Officer of Health, and a Sanitary Inspector. Each could find plenty to do in his own legitimate sphere and neither one would overlap the other objectionably in the performance of his respective duties.

The collection of articles in this present Special Number, devoted entirely to the subject of " Clean Milk " illustrates this fully. It shows the vast magnitude of the problem ; and how necessary it is that before laws controlling dairy cattle, dairies and dairymen, and the transportation, storing, and sale of milk, are drawn up, representatives of the three inspectors (medical, veterinary and sanitary) should meet in conference and discuss matters—each from his own point of view, and *each should be represented* in the final programme. That the law, as it stands at present, is not by any means perfect, can be gathered without much difficulty by every reader who peruses the head lines of our articles; and that the dairymen and milk-shop vendor, too, should be allowed to have their say is also only common sense. Even the bottle manufacturer and the inventor of devices for capping and affixing discs can have his opinion asked with advantage to the result, and our readers will find that one writer has deemed this subject of sufficient importance to devote a whole article to these two things alone.

" Clean " milk must be, and is, the slogan for the future, from this time onwards, and the practising doctor and the practising veterinarian can do a great deal to promote its production if only they will, by being particular in regard to the milk they and their families purchase and drink, set the example and put a " word in season " upon every possible occasion.

General Articles

THE NEED FOR EDUCATION IN THE HYGIENE OF " CLEAN MILK."

By ARTHUR GOFTON, F.R.C.V.S.,
Chief Veterinary Inspector to the City of Edinburgh.

In the pre-war years organised propaganda in Great Britain in relation to clean milk scarcely existed. It is true that the National Clean Milk Society was in existence, but its influence had then scarcely been felt, and its activities were mainly confined to areas in and around London which constituted its base of operations. It is also true that for many years the Public Health officers of Local Authorities,

both medical and veterinary, had been directing attention to the lack of care in regard to cleanliness in the collection and handling of milk by many of those who were engaged in the milk trade. They had also urged the adoption of measures which they hoped would be productive of improvement. Their voices were, however, almost as voices crying in the wilderness, and it is doubtful if they exercised any influence outside their own districts. The Central Authorities responsible for general public health administration encouraged local effort, but did little or nothing more.

The power to grade milk in respect of its quality and purity has been an important factor in stimulating interest and work directed towards raising the hygienic standard of milk. It has also acted as a direct incentive to the producer, the middleman, and the retailer to aim at a high standard, since it offers them a definite reward in the form of official recognition of the result which they have achieved. The authority which they receive to use the specified designations descriptive of the hygienic quality or grade of their milk, opens up a better and often a more profitable market for their produce.

Provision for the official grading of milk was first made in the Milk and Dairies (Consolidation) Act, 1915. This act consolidated the English Acts of the immediately preceding years, but as is well known, it remained inoperative till September, 1925. In 1922, however, the Milk and Dairies (Amendment) Act was passed, which, *inter alia*, conferred power on the Minister of Health to make orders restricting the sale of milk under the descriptions or designations specified in the Act, to milk producers and dealers who complied with the conditions required to obtain the necessary licence. In effect, therefore, the 1922 Act made the grading clauses of the Act of 1915 operative, whilst delaying the operation of the general clauses of the Act. The Amendment Act of 1922 also had the effect of extending to Scotland the power to grade milk; no provision for that purpose having been made in the Milk and Dairies (Scotland) Act of 1914. In terms of the Act, the Ministry of Health in England, and the Scottish Board of Health in Scotland, issued the Milk (Special Designations) Orders in 1922 which, subject to the amendments made in the following year, are still operative.

The official grading of milk under the Acts of Parliament referred to was, however, forestalled in some measure during the later war years by the Ministry of Food acting under the wide general powers conferred upon it by Parliament. The Ministry issued and administered an order for the grading of milk, but the order was concerned only with milk from tubercle-free herds. This milk was permitted to be sold under special designations at a higher price than the control

price applicable at that time to all other milk, provided it was produced under the conditions specified in the order, and complied with the hygienic standard laid down. The order of the Ministry of Food remained in operation till 1922, when it was superseded by the orders, already referred to, which were made in that year in terms of the powers contained in the Milk and Dairies (Amendment) Act. Unfortunately, and not altogether wisely, the descriptive terms applicable to graded milk, with which some degree of familiarity had been acquired during the currency of the orders of the Ministry of Food, were subject to modification in the later orders of 1922. As a result, confusion arose in the minds of many producers and consumers as to the exact significance of the authorised descriptive terms, and this confusion has not yet been cleared away.

The Milk (Special Designations) Orders may be said to have forced the attention of Public Health Authorities, traders and consumers to be directed to the hygienic quality of milk. They have certainly been responsible for active effort to achieve definite and demonstrable raising of the hygienic standard of milk. To these orders there have been added, during the past year, the Milk and Dairies Orders issued in England and Scotland under the respective Milk and Dairies Acts, together with the modernised bye-laws made by many Local Authorities under the powers contained in the Acts. The new orders and bye-laws have replaced the Dairies, Cowsheds and Milkshops Order of 1886, and the regulations made thereunder. The latter were concerned mainly with the conditions under which dairy cattle were housed, and with the structural requirements of dairies and milkshops. They made some provision for the protection of milk against the more gross forms of contamination, but, generally speaking, the methods of handling milk, as that expression is understood to-day, received practically no consideration.

In contrast, the new Milk and Dairies Orders and Bye-laws give prominence to control of the methods of handling milk at all stages between the cow and the consumer, and they bear evidence of effort to strike a reasonable balance between methods and equipment on the one hand, and structural requirements on the other.

Before material benefit can be derived from the powers which have been brought into operation during recent years, consumers, middlemen, and producers will require to be educated up to the standard which the new orders and bye-laws aim to attain. They cannot be expected to appreciate the value of that standard until they understand its significance in relation to public health. Without doubt, progress has been made in the right direction, but there is still a long road to travel. Further progress is a matter of continued

education and evolution. All who have given serious thought to the subject realise that revolutionary change is impossible and if attempted would probably be productive of more harm than good.

The Milk (Special Designations) Orders, and later, the coming into operation of the Milk and Dairies Acts in England and Scotland, were productive of discussions at many congresses concerned with public health. From these and other similar sources, and from the publication of reports of the proceedings of Local Authorities when discussing policy in relation to the acts and orders referred to, the Press has acted as a medium for conveying to the general public much information on the subject of clean milk. Evidence of the interest aroused may be found in the requests so often made nowadays to public health officials to address social organisations, and particularly women's organisations on the subject. As a result, the majority of the general public have come to recognise pretty clearly certain basal facts. Apart from the question of fraud in the form of adulteration, or the abstraction of fat, they realise that all milk is not alike and that there are wide variations in its hygienic quality as placed on the market, that the good keeping properties which characterise clean milk are lacking in dirty milk, and that a manurial deposit at the bottom of a bottle of milk is not only disgusting, but is unnecessary, avoidable and relatively easily prevented. But the general public have not yet reached the point of demanding that they shall be supplied only with milk free from preventible contamination.

It is surprising that a large proportion of the general public do not yet know that milk may be graded officially, according to its hygienic quality. And it is unfortunate that, to the average individual, the official designations descriptive of the different grades are very confusing, if not actually misleading. From lack of knowledge, mothers have too often purchased Grade "A" milk for their children in the belief that it is the produce of tubercle-free cows, and the best and safest obtainable. It is clear that there is still much need for educating the general public in regard to clean milk and graded milk. No opportunity should be lost of placing clear and precise information on the subject before the public by means of the Press, or from the platform, or through any other suitable agency which may offer. In this connection, the influence of the family physician is capable of acting as a powerful educational factor. The relationship in which he stands to the home and the family provides him with exceptional opportunities. But it is very doubtful if his influence is used as often, and to the extent to which it might be used in this direction.

In recent years, the National Milk Publicity Council in England and the Scottish Milk and Health Association in Scotland have come into existence. Both aim to increase the consumption of milk, and to improve its hygienic quality ; the two functions go hand in hand. They conduct persistent propaganda amongst consumers and producers through the agency of trained speakers for whom continuous series of meetings are arranged, generally during the winter months. The assistance of education authorities is enlisted, and facilities are thus obtained whereby the interest of the children is stimulated, and information appropriate to their age and understanding is communicated. There appears to be clear evidence that school propaganda is productive of immediate good, and it is very probable that it will bear richer fruit in later years.

Acting alone, or in combination, local authorities under the Public Health Acts, agricultural committees, schools of agriculture and education authorities have organised and carried through clean milk competitions in many districts in England and Scotland. The Ministry of Agriculture and the Scottish Board of Agriculture, as well as the two milk publicity associations already referred to, have been instrumental in suggesting and encouraging the promotion of these competitions. They are productive of keen interest and effort on the part of competitors. A first competition in a district is usually characterised by a comparatively small entry, but it is a general experience that, on repetition, there is an increase in the number of competitors. The competitions provide the visiting judges with the opportunity of directing attention to defective or faulty methods, and of suggesting improvements calculated to influence results favourably. And, since each competitor is informed as to his progress during the course of the competition, he is provided with the opportunity of checking for himself the influence of any modifications of procedure which he may introduce.

In most clean milk competitions results are assessed by the award of marks according to the methods employed in the collection and handling of the milk, the cleansing or sterilization and storage of utensils, bacterial counts, sedimentation tests and the keeping properties of the milk. For the purposes of the competition, no account should be taken of the buildings, with the possible exception that some little extra credit may, without injustice, be given to the competitor who is handicapped by the conditions under which he works, and secures results as good as other competitors more favourably situated in respect of buildings.

From what has been said it will be clear that clean milk competitions operate as an educational influence of material value. Their

influence is not confined to the competitors. They form the subject of discussion with non-competitors and that the interest of the latter has also been aroused is manifest by the conversations which take place in the course of a round of official visits during the currency of a competition. Further, they constitute a means of reaching the general public through the agency of the Press, which readily publishes the results of the competitions and reports of meetings associated therewith.

Independently of competitions, periodical bacterial counts of the milk of individual producers have a material educational value. They enable the producer to become conversant with one of the standards by which the hygienic quality of his milk is assessed, and permit him to maintain a check on his produce. They also provide him with a means of demonstrating to his workers success or failure to maintain a definite standard. One producer with whom the writer is acquainted, pays his milkers a bonus on the bacterial counts of his milk ; no bonus being payable if the minimum standard laid down is not steadily maintained. In the same establishment, as a further means of maintaining interest and effort, minor competitions are occasionally arranged between the individual workers. One of these home competitions constituted the means of converting an old conservative milker to the merits of the small top pail as a factor in the clean collection of milk. Using an open luggie pail, he was pitted against his own sons using the small top pail and decisively beaten.

The lack of continuity of labour is always a handicap to the producer, especially in towns and their surrounding districts where engagements are often on a weekly basis. Further, the labour available in town and city dairies is not usually of a high order, nor is it, generally speaking, conspicuously intelligent. Nevertheless, given the necessary personal interest and supervision on the part of the producer, results of the most commendable character can be, and are attained. The practical milker who has been dairy school trained, can generally be relied upon to produce consistently good results, but, unfortunately, the cost of this class of labour is prohibitive in all but a few exceptional cases. But there is one respect in which the practical milker trained in a dairy school could with advantage be utilised. Producers are for the most part too conservative in their adherence to old methods, and are doubtful or distrustful of modern methods. Even if open-minded and interested, they, not infrequently, lack the knowledge which would permit them to reap full advantage of the facilities at their disposal. The utilisation by Local Authorities of trained workers of the type referred to as instructors for the purpose of demonstrating modern methods, and of assisting producers to raise the hygienic

standard of the milk they produce, would constitute an educational influence of direct practical value. In order to reap the greatest benefit from their services, they should be attached for short periods to the producing establishments, and the effect of their work measured by comparison with the hygienic quality of the milk produced on the same premises before the commencement of the instructional period. Obviously success would be dependent on the willing co-operation of the producers. Whether the atmosphere necessary to achieve results exists or could be created to any material extent, is a matter of conjecture, but the experiment appears to possess sufficient merit to make it worth a trial.

The foregoing discursive remarks have been penned with the object of showing the need for education in relation to the hygienic quality of milk. The lines along which educational work and propaganda are being conducted have been indicated, but by no means exhaustively. It would be impossible, within the limits of this article to specify the whole of the agencies at work, and their special lines of activity. But probably enough has been said to show that though definite progress has been made of recent years, much more still remains to be done. In this connection tribute is rightly due to the excellent work accomplished by the National Institute for Dairy Research at Reading, whose activities, it may confidently be assumed, are not likely to wane or slacken.

THE REQUIREMENTS OF THE PUBLIC HEALTH IN RESPECT OF THE MILK SUPPLY.

By F. E. FREMANTLE, O.B.E., M.B., D.P.H., M.P.

Of all foodstuffs, as a potent instrument both of nutrition and of disease, none is equal to milk. In food value, a quart of milk is equal to nine eggs or 1 lb. of beef, or 1½ lb. of fish or poultry. It was reckoned in 1923 that a thousand calorics of energy from milk cost £35, as compared with £8 from potatoes, £33 from cheese, £44 to £58 from meat, £83 from fresh fruit and £134 from poultry or eggs. Its digestibility and its vitamin content further enhance its value.

On the other hand, milk is subject to much handling, and is an excellent food for microbes. A milk containing 56,000 microbes to the cubic centimetre will after 12 hours of a summer's day contain half-a-million; after 24 hours, 20,000,000. Of 20 samples from London dairies, only two had less than 100,000, and 10 had from 7,500,000 to 385,000,000 microbes per cubic centimetre. Small wonder that outbreaks, often of hundreds of cases, of enteric and cholera, diphtheria and scarlet fever, sore throat and epidemic

diarrhœa have often been traced to contaminated milk. The germs of tuberculosis are found in 8 per cent. of milk samples—in 1926 in 5 per cent in London, 10 per cent. in Liverpool, 18 per cent in Plymouth ; a million of our cattle are tuberculous, and some 3,000 British children die annually of drinking tuberculous milk. Surely such preventable mortality is a disgrace of the 19th century, which must be wiped out in the 20th.

The problem, then, is to provide at the house-door a cheap and plentiful supply of clean milk, free from the germs of tuberculosis. It concerns the health both of man and of animals, and the Ministries, therefore, both of Health and of Agriculture. At the farm it involves care in the health, management and breeding of the cattle ; attention to buildings, equipment and water-supply, to the milkers and their methods, to proper treatment of the milk and proper supervision throughout. In transit it depends on speed, protection and coolness, in sealed churns or bottles kept at a temperature of 40° F., with the unsatisfactory alternatives of the addition of chemical preservatives (now forbidden), heating, condensation or drying. At its destination the chief need is for proper storage of the milk.

It is pitiable that the average consumption of milk should be about one-fourth of a pint per day in this country, as compared with a pint in the U.S.A. ; that so much should be dirty and contaminated with tuberculosis and other harmful organisms ; that 1 per cent. of the milk in winter and 2 per cent. in summer should be wasted by souring—a loss only to be prevented at the present time by proper pasteurization at a cost of ½d. per gallon, or £727,500 per year for the whole British supply of 350 million gallons ; that, except for graded milk, dirty, tuberculous milk should fetch the same price as clean milk ; that more than half the supply of milk and milk-products (representing 1,570 out of 2,890 million gallons in Great Britain in 1922) should be imported, when agriculture is in desperate straits. All these points were thoroughly discussed at the World's Dairy Congress, 1923, and are fully reported in its proceedings.

But there are hopes from the awakening of the farmers to the possibilities of a clean tubercle-free milk, the greater consumption of which the medical profession will gladly and freely encourage ; hopes enhanced by the instruction in agricultural colleges and dairying classes, and by the frequent clean milk competitions, promoted by the county authorities and the National Farmers' Union ; hopes from the gradual successful enforcement in the interests of producers, distributors and consumers alike of the latest order and regulations. Success will depend on strict administration and the public enlightenment of all concerned, in farming circles, in local authorities and

electorates, in the social and political organisations, in the press and not least in the schools and amongst the teachers of the rising generation. For however carefully milk may be graded, regulations will not create the popular demand which must exist if clean milk is to become a recognised necessity throughout the land. At the present time, while it is gaining popularity, graded milk is purchased by comparatively few. The masses do not realise the dangers of dirty milk, and are consequently not prepared to pay the additional cost of milk which conforms to certain standards of quality and purity, and is therefore given a special designation and sold at a special price. The need is therefore for an all-round improvement in the milk supply, a general increase in the standard of cleanliness rather than the creation of special classes for the minority.

In this improvement the profession of Veterinary Medicine must play a large part. Its importance to the Public Health is being increasingly realised, and much is expected of the profession, not only in the practical work connected with the milk and meat supply, and in connection with the Contagious Diseases of Animals Acts, but also in the larger sphere of theory and scientific research and in the strategy and tactics of campaigns for the stamping out of disease. As glanders and rabies have now been virtually exterminated in this country in animals, and therefore in man, so must the elimination of tuberculosis in man, in the main, depend on its elimination from cattle.

WHAT IS CLEAN MILK?

By J. S. LLOYD, F.R.C.V.S., D.V.S.M. (Vic.),
Chief Veterinary Inspector to the City of Sheffield.

Clean milk to the purchaser means milk free from visible dirt, and to the public health official it means absence of visible dirt either in suspension, solution, or as sediment, combined with a low bacterial count of non-pathogenic bacteria and absence of pathogenic bacteria. Leaving out of consideration the conditions affecting milk by physiological or pathogenic agents in the udder, clean milk is the normal secretion from the normal udder of a healthy cow uncontaminated by extraneous influences or, in other words, without dirt having gained access to it.

Dirt may gain access to milk in a number of ways—dirty conditions of the milkers' hands, head or apparel; dirty conditions of the cow's flanks, thighs, udders and teats; dirty conditions of the vessels into which the milk is drawn from the udders, and the vessels or coolers through or over which milk is passed between its production and its consumption; dirt thus being able to get into the milk in the cowshed, in the dairy, in the wash-house, on the railway station, in the street,

in the conveyance, and in the home of the consumer. To prevent dirt getting into milk, extraordinary care should be taken to prevent its contact with the milk in any or all of the positions just mentioned.

There are various methods by which the presence of dirt in milk can be judged.

NAKED EYE.—This is a ready method which is only useful for visible dirt on the surface, or in sediment. It can be used as a rough means of detecting dirt left in milk which indicates exposure of the milk to blowing dust, or very dirty conditions in the cowshed. Milk having visible dirt on its surface, if exposed for sale, can be dealt with under the Public Health Act, the milk being unwholesome and unfit for the food of man. Various prosecutions have taken place and the offenders fined.

SEDIMENTATION.—This can easily be proved by allowing the milk to stand in a glass, jug or basin, pouring off the upper layers of the milk and seeing what amount of sedimentation remains at the bottom of the vessel. This is a method of showing whether the milk is produced or delivered under fairly clean conditions, and is a method by which the ordinary housewife can judge as to its dirty condition. The dairyman, in like manner, can often judge of the condition of the milk received by him by examining the bottom of the churn in which it has been conveyed. Other methods on the air pump principle, where the milk is forced through cotton wool discs, have been used, and like sedimentation afford a ready means of judging the presence of dirt.

CENTRIFUGING OR CLARIFYING.—It is usually carried out as a clarifying process in pasteurising establishments. The milk is heated to blood temperature, then centrifuged, and the scum left in the centrifuge represents the amount of dirt the milk contained. This method, however, is of little value, except to the bacteriologist, or the owner of the pasteurizing plant.

BACTERIAL COUNT.—This is a bacteriological test, the total number of organisms present being obtained by plating and cultivating the milk in Agar medium in Petri dishes. Known dilutions of a cubic centimetre of milk are taken, and the total number of colonies present per cubic centimetre after 48 hours' incubation is ascertained. Tests are also made for coliform organisms in Peptone media, dilutions of a cubic centimetre of milk being taken and incubated, using a control to judge acid and gas production for the presence or absence of coliform organisms in the different dilutions of a cubic centimetre. These methods are supposed to be the most reliable for judging clean milk production, but it lends itself to inaccuracies owing to bacteriological technique, time of sampling, care of samples, etc. I am not much

in love with the bacterial count as a means of judging the presence of dirt in milk, as it is so liable to be interfered with by circumstances arising after the milk is taken from the cow. The bacterial count can be interfered with by milking either by hand or by machine, by the method of washing the milk vessels on the farm or otherwise used in connection with the milk, whether they are simply washed with hot water, scalded with boiling water or sterilized by steam. The method of taking the samples is liable to interfere with the bacterial count, also the temperature at which the milk is taken at the time of sampling, and whether it has been cooled immediately after milking, some time after milking, or not cooled at all; the length of time elapsing between the milking and the sampling, and again by the time between the sampling and plating, and the conditions under which the milk is kept in the meantime.

Under the Special Designations Order, 1923, four grades of milk are mentioned—Certified, Grade A Tuberculin Tested, Grade A, and Pasteurized. Pasteurization, as previously mentioned, is carried out in certain large dairies, and its supporters maintain that this is the only method apart from the other grades mentioned by which ordinary milk can be made fit to be put on the market, and is an attempt to deal with milk that for various reasons is liable to contamination by dirt or other causes. To produce an ordinary clean milk is not beyond the means of an ordinary cowkeeper, provided he is up-to-date and clean in his methods, but if milk is contaminated previous to delivery, some attempt will be made by the cowkeeper to remove dirt by sieving, but there will always be some amount of dirt which no sieve will remove; that is dirt which is soluble and consequently has become dissolved in the milk. Unfortunately pasteurization will not remove this dissolved dirt, and is one reason why a certain speaker has stated that the man who pasteurizes milk is either a rogue or a fool—he is a rogue if he is attempting to put forward pasteurized milk as clean milk, and he is a fool if he is pasteurizing milk that was already clean.

This article is not intended to deal with certified or Grade A Tuberculin Tested milk, but mention should be made of Grade A milk, as judged by the test for bacterial count. Under the third Schedule to the Milk (Special Designations) Order, the following conditions apply to all holders of a licence who sell milk as Grade A.

(1) The milk shall not at any stage be treated by heat, unless a licence to sell such milk as "Pasteurized" has been granted under this Order, and where such licence has been granted the term "Pasteurized" shall be added after the designation "Grade A Milk," wherever such designation is used in

connection with the sale of such milk, or the labelling or marking of receptacles containing such milk.

(2) Milk sold as "Grade A Milk" shall be produced and treated under such conditions that on a sample being taken at any time before delivery to the consumer, the milk shall be found to contain—

(a) Not more than 200,000 bacteria per cubic centimetre; and

(b) No coliform bacillus in one-hundredth of a cubic centimetre.

Clean milk production is, therefore, our present-day problem; that is, to discover a means of obtaining a uniform standard of cleanliness in all milk exposed for sale. To my mind, taking into consideration the various mechanical and bacteriological test results, in order to obtain a reliable guarantee of cleanliness in the milk industry, it is essential that the herds be examined periodically by a veterinary surgeon and a satisfactory standard of hygienic requirements and methods be obtained by supervision at the source of production and *en route* to the consumer.

Under the Milk and Dairies Order of 1926 provision is made for the registration of both dairyman and premises, health and inspection of cattle, precautions to be taken by cowkeepers for the cleanliness of their premises, special precautions applicable to buildings used for the storage and selling of milk, and for the conveyance and distribution, cleanliness of churns, etc. This Order has superseded the old Dairies, Cowsheds and Milkshops Order and the regulations made thereunder, and is now in itself the accepted regulation for the requirements just mentioned. If the Order is universally enforced, inspection under it regularly carried out, its regulations complied with by dairymen and cowkeepers, the consumers will get milk practically equivalent to Grade A, whilst the purveyors of milk will not be required to get a licence for Grade A milk, or be liable to prosecution for failure to comply with the conditions required by such licence. It is up to all the parties concerned to see that milk is produced under cleanly conditions and supplied in such a manner to the consumers. It still remains with the latter to see that the milk is properly kept clean after coming into their possession.

THE QUESTION OF CLEAN MILK FOR CENTRAL LONDON.

By C. W. HUTT, M.A., M.D., D.P.H.,

Medical Officer to the Borough of Holborn.

THE problem of securing a clean milk supply in a Central London area is one of considerable difficulty. It is only partially met by the

institution of the " designated " milk. Comparatively few retailers have much demand for this milk and the amount retailed by some licence holders is very small; the Public is not disposed to pay the higher price charged for designated milk; indeed, many of the poorer inhabitants could not afford to do so. The value of the Milk (Special Designations) Order is, to no small extent, in its educational effects. The existence of such arrangements shows milk producers that clean milk can be produced on farms and that medical opinion has been able to convince the representatives of the public of the importance of keeping milk as free as possible from bacteria and, above all, from tubercle bacilli.

In the year 1922 arrangements were instituted in Holborn for the systematic examination of samples of milk for the presence of dirt. The routine covers the ascertainment of the amount of dirt deposited by a certain volume of milk; it is found useful in that it is a handy measurement, the examination being readily carried out in the absence of a bacteriological laboratory. In cases where dirt has been found in any considerable quantity further samples have been obtained and submitted to the Borough Analyst for examination.

In the five years 1922-26 455 samples were examined for dirt in the Public Health Department. In 13 of these dirt was disclosed, ranging from a trace up to 17 parts per 100,000 by volume. During the same period 23 samples were submitted to the Borough Analyst, 21 being certified as containing dirt, the amount ranging from a trace up to 2·2 parts per 100,000. *It will therefore be seen that in the five years of routine work seven per cent. of the samples examined gave evidence of the presence of dirt.*

The examination for dirt referred to above cannot, of course, be compared for efficiency with bacteriological examination. In the same five years (1922-26), 103 samples were submitted for bacteriological examination for (1) tubercle bacilli, (2) organisms per c.c. at 37° C. and (3) minimal volume containing *B. coli*. *Ten samples showed definite evidence of tuberculous infection, whilst amongst the organisms found in addition to tubercle bacilli and B. coli were B. faecalis alkaligenes, B. enteritidis sporogenes and streptococci.*

The number of organisms found on bacterial counts, as will be seen from the following table, ranged from 9,760 to 25,000,000 per c.c.

Date of Examinations.		Number of Organisms per c.c. Grown at 37° C.
Year.	Month.	
1922	November	9,760
1923	,,	11,750
1922	,,	12,600
1922	,,	14,940
1925	,,	21,700
1923	,,	28,000
1923	,,	32,000
1924	,,	33,100
1924	,,	37,250
1925	,,	44,000
1925	,,	51,000
1924	,,	51,250
1925	,,	52,400
1923	,,	55,000
1924	,,	57,650
1922	December	83,000
1926	,,	90,000
1925	November	96,000
1926	October	125,000
1923	November	240,000
1922	December	279,000
1924	November	328,400
1922	December	352,000
1923	November	420,000
1924	,,	423,000
1926	,,	3,900,000
1926	July	5,600,000
1925	November	11,250,000
1926	August	25,000,000

Having discovered a dirty or infected milk, all possible action is at once taken to improve the retail conditions and prevent contamination in the shop, or on the round; but in most cases it is impractical to supplement this with effective action to deal with the milk at the place of production, because the place of production cannot be ascertained.

Take for example a grossly contaminated sample which was found to contain dirt to the extent of 17 parts per 100,000. It was ascertained that this very dirty milk was a "mixed milk" from a creamery supplied from "many hundreds of dairies." *The modern practice of collecting milk from many farms to large creameries and milk depots where the milks are mixed and pasteurized effectively prevents, in most cases, the possibility of tracing dirty or infected milk to the source of production and the results of our investigation bring out the fact that the practice of mixing milk from various farms before sale to the customer has the disadvantage of rendering almost void the efforts of local authorities, remote from the place of production of milk, to trace the source of contamination of milk*

consumed by the inhabitants of their areas. This makes all the more necessary inspection of dairies, milking and herds by the local authorities of the areas in which the milk is produced, and examination of the milk, not only as it enters the large creameries where it is mixed, but also as it leaves, for from time to time it would seem that certain of the churns of milk supplied by the farmer are, by error, not emptied in the mixing vats, but pass out in their original state, escaping the cleansing process which, unfortunately is the chief safeguard to-day to prevent the presence of dirt in milk.

COMPARISON WITH COPENHAGEN.

It is interesting to compare the condition of the milk supply in London with that of Copenhagen. In Copenhagen objection is taken to the presence of any dirt; milk which after standing two hours gives a noticeable deposit is considered as polluted to an inadmissible degree. If dirt is found in milk obtained from a producer, after the first offence the producer runs the risk of not being allowed to sell his milk in Copenhagen. It is significant that of 11,000 samples which were examined for dirt in 1923, only five were found to contain dirt.

THE SUPERVISION OF THE LIVERPOOL MILK SUPPLY.

By T. EATON JONES, F.R.C.V.S.,
Chief Veterinary Officer to the City of Liverpool.

THE importance of a pure milk supply has long been recognised by the Liverpool Health Committee and its officials.

So long ago as 1900, special powers were obtained under the Liverpool Corporation Act. These dealt chiefly with annual licensing of town cow sheds and the question of tuberculous milk, both in town and country herds.

All this was in addition to the general powers under existing acts and those of the Model Milk Clauses under the Dairies, Cowsheds and Milkshops Orders, 1885 to 1899.

The result of this campaign was such that a high and definite standard was in existence when the Milk (Special Designations) Order of 1922 came into force.

The licensing of premises achieved a great deal when compared with registration as laid down in the old Dairies, Cowsheds and Milkshops Orders.

Of the whole supply of wet milk, about two-thirds is derived from the surrounding counties and one-third is produced within the City boundaries.

There are approximately 300 town cowsheds housing about 3,800 cows.

The latter are usually purchased soon after calving at the height of their milking lives and are kept in the cowsheds for an average of nine to ten months, when they are disposed of for slaughter.

A few of the cattle are turned out daily in the summer months, and a limited number are bred from, either in the rural areas or are sent further afield after having milked for a while whilst in calf.

Although nine to ten months is the average profitable milking period, there are some notable exceptions to this, and one has heard of cows continuing to milk satisfactorily for three and even seven years without mating.

Shorthorns are the chief breed.

The majority of the cowkeepers belong to an association whose objects are along progressive lines. An annual show is held which receives the support of the Corporation, and at the moment the association is presided over by a consulting physician who is also a member of the City Council.

The prevailing type of cowshed is one possessing one or two rows of stalls, the heads being to the wall and with a wide passage. Feeding is carried out with tubs and the stalls are double. Floors are impervious and there is a deep dung channel so that the animal's hindquarters rarely become soiled.

Grooming is constantly carried out.

During the last year or so there has been a marked increase in the use of automatic watering troughs.

Considerable attention has been paid to the structure and the sanitary supervision of the midden.

During the warmer months of the year a staff is concentrated upon anti-fly work.

Separate cooling rooms are now pretty general.

Difficulties have been experienced in introducing covered milking pails, but some are in use. Certain types of milking machines have been used, but after extensive trials have been abandoned.

A varnished notice emphasising the following points has been circulated :—

"AIDS TO CLEAN MILK PRODUCTION."

"THE MILKER :—

Milk only with clean, dry hands.

Do not put the fingers into the milk or cans.

Do not handle milk or cows if you have recently had any infectious disease.

Wear a clean overall during milking.

"THE COW :—

Groom daily and let the dust settle before milking.

Keep the hair at the end of the tail and on the udder clipped.
Clean the udder and teats with a wet cloth just before milking.
Do not feed hay during milking, it creates dust.
Milk a case of Garget LAST, into a vessel not used for dairy purposes, and containing a little disinfectant. Do not milk it on to the floor.
Put animals which are unwell by themselves.
Reject the fore milk.

" THE COWSHED :—

Keep as clean as possible throughout.
Empty the midden as often as possible.
Use only dry, clean bedding.
Keep the feeding material as far away as possible from the milking shed and milk.
Admit as much fresh air as possible.

" THE MILK AND UTENSILS :—

Keep dogs, cats, chickens, flies, etc., away from the milk.
Covered milking pails should be used.
Wash out the pails with cold water as soon as they are finished with.
Then SCALD them thoroughly and leave them to dry, mouth downwards, in a clean place.
Cool the milk away from the cowshed and *keep it cool.*
Clean the milking stool.

REPORT ABNORMALITIES OF UDDER AND HEALTH.

T. EATON JONES, F.R.C.V.S.,
Veterinary Department, Chief Veterinary Officer."
30, Hatton Garden, Liverpool.

Since the coming into force of the Milk and Dairies Order of 1926, copies of the Order have been circulated to all milk producers in the city and the diseases of cattle from which the milk must not be used have been fully explained, as have also those scheduled by the Milk and Dairies (Consolidation) Act of 1915.

The udders of all cows are subjected to periodical veterinary examination and advice is tendered on many points of a milk production nature.

In addition to this, a lay inspector is fully occupied in getting round all the cowsheds four or more times a year to see that the cowsheds, cattle and everything appertaining to milk production are kept in a proper cleanly and sanitary condition.

During the veterinary examination, any defective udders which cannot be satisfactorily accounted for on purely clinical lines are

dealt with by a sample of milk being taken and submitted to microscopic examination. If necessary, samples are sent to the City Bacteriologist for the biological test.

Combined clinical and microscopic examination forms one of the surest means of removing the tuberculous udder from the milk supply.

In direct samples from tuberculous udders, microscopic examination has revealed the presence of acid alcohol-fast bacilli in over 80 per cent. of cases. Immediate slaughter has confirmed these findings.

On the other hand, cases occur from time to time in which the biological test is negative despite the presence of acid alcohol-fast bacilli on microscopic examination. The udders from which such samples have been taken have been clinically typical of tuberculosis of the udder ; *post-mortem* examination has revealed a picture identical with tuberculosis of the udder, and when sections have been made from the udder, a typical histology with giant cell formation has been discovered. The value of occasional cases such as these is to impress upon the mind that whilst a positive result of guinea-pig inoculation is definite evidence of tuberculous infection, a negative result, however, does not absolutely mean that the udder was not affected with tuberculosis.

The town supply is tapped from time to time and bulk samples are sent direct to the City Bacteriologist.

When occasion requires, sympathetic consideration is given to cowkeepers who desire to eliminate tuberculosis from their herds.

An unsatisfactory feature is the hawking of milk by small vendors when there is a surplus on the market.

The milk derived from the country is bulk sampled as often as possible and tuberculous samples are now followed up by the veterinary officers in company with those of the County concerned. There is no doubt that in the past the local act brought about a great improvement in the herds, premises and methods.

The Hospitals Committee have recently initiated a policy for the purchase of Grade A Tuberculin Tested Milk and as time goes on no doubt the amount purchased will gradually increase.

In the past, farms supplying hospital milk have been subjected to rigid periodical veterinary inspection.

The same policy has been in vogue for years with regard to the Health Committee's supply to their centres for Infant Welfare purposes.

In 1925 the Chairman of the Hospitals Committee and the Chief Veterinary Officer made an inspection of numerous graded farms in the south and their views were expressed in a Report to the City Council.

XUM

During last year the Chairman of the Health and Hospitals Committees accompanied by a deputation of City and neighbouring county milk producers, the Medical Officer of Health and the Chief Veterinary Officer visited the Continent to study questions arising out of clean milk production. Their conclusions were expressed in a report to the City Council early this year.

Several retailers have obtained licences to sell Certified and Grade A T.T. Milk and with the official campaign it is felt there must be an increase in the consumption of these products.

There is no doubt, however, that county authorities could, both by veterinary and sanitary routine inspection, greatly improve the quality and reduce the amount of tuberculous infection in milk coming into the City.

THE PROBLEM OF A CLEAN MILK SUPPLY FOR LONDON.

By J. B. HOWELL,

Medical Officer of Health for the Borough of Hammersmith, London, W.

THE problem of a clean milk supply, as it affects the Metropolis, is now confined to the questions of distribution and of the small trader. The days of the insanitary, ill-ventilated town cowshed, have, happily, passed and practically all the milk consumed in London reaches us by road or rail from the country.

In the Borough of Hammersmith very large quantities of milk arrive daily at the L.M. & S. Railway Station at Willesden Junction, from farms in all parts of the country. Much of this milk is transferred by trains to other parts of London and the suburbs. The remainder is conveyed by motor lorries to the premises of local dairymen and wholesale dealers.

Periodical inspections are made at the station to ensure, as far as possible, that the milk is not unnecessarily exposed to contamination.

The new design of churn which is coming largely into use is helping to this end, and the provisions of the Milk and Dairies Order, 1926, prohibiting the opening of any churn or vessel in any railway van or on any railway station, should further safeguard the milk at this stage of its journey from the cow to the consumer.

The majority of small traders in this borough obtain their supplies of milk from wholesale dealers, who deliver by lorry to the traders' premises. The greater part of the milk is delivered in closed churns, but when small quantities are required, the milk is measured out of a churn on the lorry into hand cans. The opening of the churns in the streets renders the milk liable to contamination by dirt and dust from the roadway. The hands of the carmen who have to measure

out the supplies are often far from clean, due to the handling of the churns, etc., and often come into actual contact with the milk.

In some towns in the North of England regulations are in force to prohibit the transfer of milk from one vessel to another in the open streets. Similar regulations applied to London would be of assistance.

One of the big difficulties with regard to a clean milk supply in London has been with regard to the premises of the small trader.

A few years ago a systematic investigation was made in the Borough of Hammersmith, as a result of which 54 premises were removed from the register of milkshops. From many "general" or chandlers' shops at which milk was retailed, coal or coal blocks, firewood, hearthstone, soap, greengrocery (potatoes, onions, etc.), paraffin oil, pickles, vinegar and other dirty, dusty, and strong-smelling goods were sold. Many of the shops were in a dirty condition and even when the shopkeeper was a clean and careful person, the crowded condition of the shop and the fact of the floor being permanently lumbered up with boxes, barrels, firewood, etc., effectually prevented proper cleanliness.

It is now the practice in this Borough, before consideration is given to an application for permission to sell milk, to require a written undertaking from the applicant that he will not sell any of these articles.

The premises used for the sale of milk must be efficiently lighted and ventilated, and must not communicate directly with any room used for sleeping or with any water closet. The floor of the shop must be kept clear, so as to allow of effectual cleansing, and all vessels containing milk must, at all times, be kept properly covered. Frequent inspections are made to see that these regulations are complied with.

The delivery of milk to the consumer in glass bottles has, of recent years, greatly increased, and in such cases the Milk and Dairies Order requires that the bottles shall be filled in the dairy.

The present state of legislation, however, still permits milk to be retailed in the streets from hand cans. These hand cans must, of necessity, be opened for varying periods whilst the milk is being measured out and thus expose the milk to contamination from manure and dirt from the roadway.

The question of cleanliness of milk bottles is one which receives special attention in this Borough. In a number of cases the washing of bottles has been found to be carried out in a casual manner, and constant supervision is necessary to ensure clean bottles.

The ideal milk supply would be one produced under ideal conditions and bottled at the farm, as is the case with "certified" milk. The cost of transport to the towns would, perhaps, prevent the adoption of such a system on a large scale. Although not attaining

our ideal, the system in operation at one dairy in this Borough has much to commend it. All milk to this dairy is delivered direct from the farms to a private railway siding on the premises. From the time of its arrival until it leaves the premises in bottles, the milk is subjected to the minimum of exposure and handling. After pre-heating, the milk is passed through a series of pipes to a number of centrifugal clarifiers. From these it is conveyed by a further series of pipes to " pasteurizing " plant of the " Holding " type, from whence, after cooling, it is passed to numerous automatic bottle filling machines. After every batch of milk has been dealt with, the whole of the plant, including all pipes, is thoroughly cleansed with boiling water.

In use at these premises are some of the largest bottle washing machines in the world. An average of 40,000 gallons of milk per day is dealt with at this dairy.

Although much still requires to be done before a satisfactory milk supply is assured, considerable improvement has been made during recent years in the milk supplies of London.

The latest Milk and Dairies Order, *if properly carried out*, will undoubtedly make for a cleaner and purer supply, *but constant inspection and supervision is necessary to ensure that the regulations are complied with.*

PASTEURIZATION—A SAFEGUARD OF PUBLIC HEALTH.

By P. B. TUSTIN,

Technical Adviser to the United Dairies Company, and late Chairman Milk Producers and Milk Distributors' Committees, Canadian Food Board.

PASTEURIZATION immortalises the name of Louis Pasteur, a Frenchman, and one of the world's greatest scientists.

Pasteur's great discovery was that decomposition of food, fermentation, putrefaction, and other forms of decay were due to the activities of living organisms. He showed that fermentation of wort or grape juice was due to living organisms of yeast, not as Liebig claimed, by autogenous decomposition communicated to the sugar by decomposing yeast.

Pasteur showed that the souring of wine and milk were due to different acid-forming micro-organisms. Having isolated these organisms, Pasteur proceeded to determine their thermal death rates. To obtain complete sterility of milk, Pasteur found it necessary to raise the temperature to 230° F. for two minutes. The experiments foreshadowed the three processes at present in use for the preservation of liquid milk, i.e., sterilization, at a temperature of 212° F. to 230° F ; flash pasteurization, 175° F. to 185° F. ; low temperature holding 145° F. for 30 minutes, as required by the Ministry of Health.

Sterilization is useful where milk has to be kept for prolonged periods, in cases where fresh milk is unobtainable.

Flash pasteurized milk is better than raw milk for adults, because harmful organisms are destroyed, but unfortunately this method alters the chemical constituents of the milk by destroying the cream line, coagulating the albumen, precipitating the milk sugar, casein, and salts, and giving a distinctly cooked flavour. It is not, therefore, so good for children.

Low temperature pasteurization at 145° F. holding at that temperature for 30 minutes has none of the above-mentioned objections, as it destroys all harmful organisms, such as diphtheria, streptococcus, typhoid and tuberculosis, but does not change the nutritive properties. It does not harm the vitamines, and it retains a good flavour and natural cream line.

There are various types of pasteurizers for the treatment of milk by the low temperature holding method, and this may roughly be divided into the following classes: positive holding, "Batch pasteurizers," "pocket positive holders," "continuous flow," and "in bottle" pasteurizers. The process is as follows—in all modern plants milk arriving from the farm is bulked in large tanks, where it is brine cooled to a minimum temperature of 40° F., when the run is started; the milk first passes over a pre-heater, where the temperature is raised to 95° F. It then flows through the centrifugal clarifiers or filter, where all extraneous matter is removed, then it goes to the pasteurizer, where the temperature is raised to 145° F., from the pasteurizer to the holding tanks, where the milk is held at 145° F. for 30 minutes; then over the water and brine coolers, where the temperature is reduced to 40° F.; then to the bottle fillers and automatic cappers, where the milk is sealed in the final package, untouched by hand throughout the whole process.

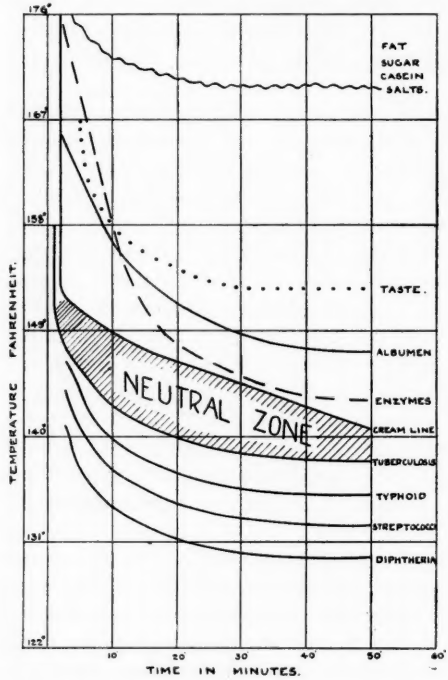
Batch Pasteurizers.—In this type the milk is heated in coil vats or glass-lined tanks with a capacity of from 200 to 1,200 gallons each. In coil vats the hot water flows through a slowly revolving coil and heats the milk up to 145° F. In the glass-lined tanks a hot water jacket supplies the heating medium, and the milk is constantly agitated during the process.

Pocket Holders.—In this type the tank is divided into a series of six to ten pockets which fill and empty in turn, and are so timed that the holding period is positively 30 minutes.

Continuous Flow Holders.—In this type the milk flows in an unbroken stream through a series of tanks, and from the time it enters the first tank, until it reaches the exit of the last tank, 30 minutes is supposed to elapse. Unfortunately this is not the case. On a colour

test it has been shown that some of the milk passes through in from 10 to 15 minutes, due to currents set up by thermal differences, and harmful organisms have been known to pass through without being destroyed.

In Bottle Pasteurizers.—By this method milk is heated in the final container. At first sight, this appears the ideal method, but it has the following objections: To heat the milk in the centre of the bottle to 145° F. it is necessary to overheat the milk at the side of the bottle; room has to be allowed for expansion of the milk, so the bottle cannot be filled, and the breakages are enormous.



Practically all the batch and pocket types of holders are efficient, if the preliminary sterilization of all plant and equipment has been properly carried out, and there is thermostatic control of the heating and cooling mediums and the milk.

There are certain faults which have to be guarded against by dealers in purchasing pasteurizing machinery, and there are certain features which should be embodied in the ideal pasteurizing plant. The efficiency of any milk-pasteurizing plant is governed by the knowledge of those operating it.

The most general mistakes made by dealers in selecting milk plant equipment are as follows: (a) too many pieces of machinery; (b) machinery of too complicated a type; (c) machinery of different capacities necessitating running parts of the equipment too fast and other parts too slow.

In installing new equipment and to avoid mistakes, the following points need careful consideration:—

1. Simplicity of machinery; few parts.

2. Ease of cleaning; every part accessible; should be easily sterilized with live steam; avoidance of washers and gaskets; all parts should be metal.

3. Short run from receiving tank to bottle filler; milk going through or over as few pieces of apparatus as possible, and a minimum amount of piping connecting plant.

4. Durability; the best is never the cheapest, and initial outlay in good equipment will more than pay for itself in avoidance of breakdowns, etc. Tinned copper looks very much alike, but copper plate varies a great deal in quality, and there are 22 thicknesses of copper plate on the market. Tin should be of 100 per cent. quality, and not an inferior alloy.

5. Proper capacity. The equipment should be capable of handling present business and a reasonable increase.

6. Economy of operation, using the minimum of labour to operate, clean and sterilize.

7. Avoidance of extremely high temperature of heating medium by having sufficiently large heating surface.

8. Accuracy of holding period and temperature.

9. Avoidance of forcing milk through at too high a speed; steady natural flow.

10. Unnecessary agitation of milk.

11. Floor space required.

12. Minimising human element in operation.

In my opinion, the last word has not been said on the type of pasteurizer.

I believe we are on the eve of great discoveries relating to the treatment of milk, such as the application of ultra-violet rays with the vacuum principle, possibly electric or other means of destroying harmful organisms.

The veterinarian perhaps more than any other professional man, is in a position to realise the value of pasteurization to the health of the community. He knows better than anyone that the tuberculin test, while a most valuable agent for eradicating the infected animals from herds, is not 100 per cent. efficient. He knows that cases of T.B. reactors are found in certified and Grade A (T.T.) herds. He also knows that there are other harmful organisms that need to be destroyed.

Pasteurization should not be an excuse for dirt. Neither should cleanliness be a reason for not pasteurizing. No effort should be relaxed in encouraging the production of clean milk. Having got clean milk, let us use this simple safeguard so that the public can

have confidence in the supply, and have no doubts when feeding their children on nature's finest food. Likewise veterinarians should point out the advantages to the live-stock breeder of pasteurizing the skim milk, buttermilk fed to livestock and poultry.

The dairy industry is one of the most, if not the most, important industry in the country. It means, when properly carried out, a more prosperous agriculture, increased soil fertility, better live-stock and healthier nation. The consumption *per capita* is only half what it should be; due to lack of confidence on behalf of the public. We can all, veterinary surgeons, medical officers of health, sanitary inspectors, producers and distributors, join hands in our efforts to improve and elevate this industry, so that all the milk produced in our country can be consumed as fluid milk, thereby greatly improving the health and wealth of the nation.

THE PRODUCTION OF CLEAN MILK v. PASTEURIZATION.

By F. EDWARD SOMER, F.R.C.V.S., D.V.S.M.,
Veterinary Department of the City of Birmingham.

During the past few years milk has occupied the minds of the general public more than that of any other food.

This is only what one would expect considering the great part which milk plays as the main food for children. In many of the large cities there have been extensive milk campaigns, pointing out to the public the advantages of milk as a food, advocating the consumption of more milk per head and giving advice on the care of milk in the home. My attention has often been drawn to large placards with the words, "Drink more Milk" on them, and I have often thought that they would have been much better if worded, "Drink more *clean* Milk," and that more instruction should be given to the general public on what this essential word implied. There is no doubt that the average milk of to-day is produced cleaner than it was years ago, but there is still a very great deal to be done to bring all the milk produced up to a fairly high standard of cleanliness. The interest taken by the general public in the milk they buy is becoming greater every year, as witnessed by the demand for the various grades of milk which are now produced. This demand is increasing and will, I hope, go on increasing until the demand for graded milk from the milk retailer will in turn react on the farmer, who will then *have* to supply clean milk to the wholesaler, or direct to the public, as the case may be.

What the consumer should demand is a clean milk—unadulterated and free from germs able to cause disease—and having secured it, he

should keep it as clean as possible: and in the summer time as cool as possible.

Perhaps at this stage I had better give my definition of clean milk. Clean milk may be defined as milk obtained from healthy cows, containing no bacteria likely to cause disease, and coming up to the bacterial standard of Grade A milk, i.e., " that the milk shall be produced and treated under such conditions that on a sample being taken at any time before delivery to the consumer, the milk shall be found to contain :—

(a) not more than 200,000 bacteria per cubic centimetre; and

(b) no coliform bacillus in one-hundredth of a cubic centimetre."

The opinion of the Ministry of Health of milk produced up to this standard is to be found in Circular 356, " Milk and Dairies (Amendment) Act, 1922," and reads as follows :—

" The Minister is advised that the conditions now prescribed for 'Grade A' milk are such as should provide milk that is superior to the ordinary milk of the country and reasonably safe under all circumstances, and at the same time bring the production and distribution of the milk within the competence of all careful dairymen."

I have taken the standard of Grade A milk as the standard which should be applied to clean milk, because milk can be produced economically, and in large quantities, which will come up to this standard, as I shall show later.

The question will probably arise in your minds: If milk up to this standard can be produced in large quantities and economically, how is it so much dirty milk is sold?

One of the chief obstructions to the production of clean milk has been the wide diversity of opinion expressed by the so-called experts. You find one man advocating nothing but pasteurised milk, another advocating sterilized milk, and another will have nothing to do with milk unless produced from cows which have passed the tuberculin test.

I wish it to be most clearly understood that I am a firm supporter of clean milk obtained from tuberculin tested cows, and feel certain that progressive farmers of to-day realise the advantages to themselves in having tubercular free herds, and that there is an increasing demand among the public for this milk. Realising the extent to which tuberculosis is found amongst our dairy cattle, and the initial cost to the farmers in building up tubercular free herds, I feel that only very steady progress will be made in this direction.

In the meantime the ideal is to get a vast supply of clean milk as cheap as possible, and as free from infection by tubercle bacilli as we can get it.

In connection with the production of Grade A milk, all the cows are submitted to a clinical examination every three months by a veterinary surgeon as a safeguard against tubercular infection of the milk. This examination does not entirely eliminate the possibility of infection of the milk, but if carefully carried out and combined with periodic biological examinations for tubercule bacilli in milk samples, taken from the herd, it reduces the risk of contamination to a great extent.

I should like to put forward the suggestion that it should be made compulsory for all milk producers to have their cows clinically examined by a veterinary surgeon every three months, and that it should be necessary for them to submit a certificate to their registration authorities that this has been done and that their herds are free from cows showing clinical symptoms of tuberculosis. This would help to reduce the incidence of tuberculosis in milk. In connection with my work in Birmingham, I visit during the course of the year many farms which are sending milk contaminated with tubercular bacilli into the city. If these herds had been submitted to a clinical examination every three months, many of the cows which I find affected with tuberculosis of the udder would have been slaughtered under the Tuberculosis Order a long time prior to my visit. Notification of suspected tubercular udders by owners only leads to delay in notification due to inexpert examination (and what a costly delay it is if reckoned in children's lives), whereas, if these cows had been regularly inspected by an experienced Veterinary Surgeon, they would have been detected in the early stage of the disease and dealt with under the Tuberculosis Order.

Among the Birmingham wholesale milk dealers we are very lucky in having a great pioneer in the clean milk question, who has probably done more good in obtaining a large supply of clean milk for Birmingham than a vast amount of legislature has been able to do. This gentleman has been selecting his milk supply for some time, rejecting farmers who sent in dirty milk, and taking on in their places farmers who were likely to send in cleaner milk.

In 1922 he started a vast clean milk scheme, arranging a clean milk competition amongst his senders and paying them according to their results. Milk samples are taken from the various senders at intervals during the month and submitted to a bacterial count, and the first 12 farmers on the list with the lowest bacterial count receive 1d. per gallon above contract price. The next 24 farmers on the list receive ½d. per gallon more for their milk. Lists are sent round every month to the farmers showing them their position on the list, and there is very keen competition amongst neighbouring farmers to obtain

AVERAGE BACTERIAL COUNTS FOR THE MONTHS OF JANUARY, 1923-4-5-6, OF SENDERS TO THE ABOVE DEPOT.

Farmers supplying Milk with—	Jan., 1923.	Jan., 1924.	Jan., 1925.	Jan., 1926.
(A) Bacterial Count.				
Under 30,000 bacteria per c.c.	20	33	46	82
Expressed as % of farmers sending milk to this depot	21.9%	31%	41%	51%
(B) Bacterial Count.				
Under 200,000 bacteria (Grade A Standard) per c.c.	73	82	104	133
Expressed as % of farmers sending milk to this depot	80%	78%	92%	93%

In case this chart does not at first appear quite clear, taking January, 1926—Bacterial Count under 200,000 bacteria per c.c.—it will be seen that 133 farmers supplied milk of this standard, and these 133 farmers represent 93 per cent. of the total farmers supplying the dairy.

As I have started away by giving January, which is probably one of the best months for clean milk production from the point of view of low temperature to which the milk is likely to be cooled to, and kept at before bacterial counts are made, I will now give figures for the month of June.

Farmers supplying Milk with—	June, 1922.	June, 1923.	June, 1924.	June, 1925.	June, 1926.
(A) Bacterial Count.					
Under 30,000 bacteria per c.c.	13	30	19	37	83
Expressed as % of farmers sending milk to depot ..	18%	33%	19%	28%	59%
(B) Bacterial Count.					
Under 200,000 (Grade A Standard)	32	51	36	66	115
Expressed as % of farmers sending milk to depot ..	45%	57%	36%	51%	82%

higher positions in the list; and to top it, if possible. At the same time pamphlets on how to produce clean milk are distributed to the farmers, and in many cases farmers are visited individually and advice given on clean milk production.

The statistics show the progress that has been made in the production of clean milk by senders to the above depot.

From these charts it will be seen that there has been a vast improvement in the milk supply to this depot since the commencement of the scheme in 1922. This improvement has been the result of education and competition plus the extra payment to the successful first 36 farmers on the list. One unfortunate point, however, arises, in that the milk from farmers who have not tried to improve their milk, which do not come within the 200,000 bacteria per c.c. standard, or close to it and has therefore been rejected, goes to someone else not so particular as to his supply and reaches the public by this channel. It is time that the law was so framed that this could not be possible.

The next question that arises is, does all this trouble pay for itself! There is only one answer and that is YES—it pays the wholesaler, and it pays the farmer. The wholesaler can supply a good clean milk to the public which he knows will keep for a reasonable time if treated properly in the home, and he gets a good name amongst his customers, and the farmer does not get an occasional churn of milk returned to him, which has gone sour, a far from uncommon occurrence to the dirty farmer.

In October, 1926, an analysis of the records shows that:—

20 farmers were supplying milk with a bacterial count under 5,000 per c.c.

70 farmers were supplying milk with a bacterial count under 10,000 per c.c.

111 farmers were supplying milk with a bacterial count under 200,000 per c.c.

There are many factors governing the production of clean milk, and there is great diversity of opinion amongst the so-called experts as to which plays the most important part. One man looks upon properly constructed sheds as the chief factor; another upon the cleanliness of the cows; another on the cleanliness of the milking vessels and churns; and another upon the adequate cooling of the milk immediately after each cow has been milked. These all play their part and are so intimately connected one with the other that all are necessary.

In my opinion, if a farmer is interested in clean milk production, and has been educated how to produce it, and is determined to be clean

in everything he does in connection with milk, then that farmer will produce clean milk, even if he is under very adverse conditions.

Many of the farmers who are producing milk in the 5,000 bacteria per c.c. standard are doing so in sheds which are far from being well constructed from the hygienic point of view—their floors are bad, drains bad, and the lighting, ventilation and air space per cow are far from adequate. These farmers produce such clean milk because they are determined to treat everything in connection with their milk in as clean a manner as possible. If they can do it under these conditions, they would do it much more easily with better sheds and with much less work. On the other hand, there are one or two farmers who only just come inside the 200,000 bacteria per c.c. standard, who have good sheds and much better conditions in general to work under. Their bacterial count would be much higher if they had to work under more adverse conditions.

The work carried out in connection with the above clean milk work has clearly shown the advantage of a steam jet for use on the farm for cleaning milk pails, milk cooler, etc., used on the farm. Farmers who are equipped with a steam jet for the final cleaning of their vessels are much more consistent in sending in milk below the 5,000 bacteria per c.c. standard than are the farmers who are not so fortunately equipped.

My intention in this paper being to show that a large supply of clean milk can be produced under ordinary conditions and with reasonable care, I will not enter into a detailed discussion on " How to produce clean milk," about which so much has already been written.

Pasteurized Milk.

Coming to pasteurized milk. The conditions subject to which licences for selling milk as " pasteurized " may be granted are laid down in Part IV, The Milk (Special Designations) Order 1923, and are :

(1) The milk shall be retained at a temperature of not less than 150° Fahrenheit for at least half-an-hour, and be immediately cooled to a temperature of not more than 55° Fahrenheit.

(2) The milk shall not be so heated more than once, and shall not be otherwise treated by heat.

(3) The type of apparatus used for pasteurizing and the methods employed shall be such as are satisfactory to the licencing authority.

(4) Every vessel containing the milk shall bear a suitable label with the words " Pasteurized Milk."

(5) On a sample of milk being taken after pasteurization and before delivery to the consumer, the milk shall be found to contain no more than 100,000 bacteria per c.c.

It will thus be seen that the description " pasteurized " in connection with the sale of milk is prohibited, except in relation to milk which has been subjected to an efficient method of treatment, and cannot be applied to milk which has been treated by the " flash " method, in which the milk is heated for about half a minute to a temperature varying between 160° F. to 185° F. Pasteurization by the " flash " method is almost wholly a commercial procedure. It is not prohibited under the order, and wholesalers may continue to treat milk by this process, but cannot sell the milk as " pasteurized " milk.

Pasteurization is carried out by the wholesaler, not with the idea of protecting the public, but to make the milk keep until marketed. It is absolutely unnecessary for clean milk to be so treated, as it will keep longer than dirty milk which has been pasteurized. The public are misguided by the word " pasteurized." They think that this milk is safer than ordinary milk, and does not need care in looking after it in the home. This is far from being the case—the bacteria not killed by pasteurization will grow rapidly when the milk is stored, and sooner or later the number of bacteria in pasteurized milk will exceed the number in clean raw milk. Pasteurization does not kill all the organisms present in milk. The percentage killed varies in different samples from 98 to 70 per cent. The " holder " method of pasteurization is much more satisfactory than the " flash " method, not having such an effect on the cream column and reducing the bacterial content to a lower count. I think the general opinion of bacteriologists is that the " holder " method, as carried out at present, cannot be relied upon to destroy all tubercle bacilli that may be present.

Pasteurization is only a palliative measure and does not help towards the production of clean milk, which should be our first aim. It does not turn dirty milk into clean milk. In fact, the results are not satisfactory when dirty milk is so treated, and most wholesalers now realise that for successful pasteurization they must have a reasonably clean milk to start with.

Our aim should be to educate the farmer to produce a still cleaner milk and to educate the public to the benefits of clean raw milk, and then there will be no need for such milk to be pasteurized to lengthen its keeping qualities.

Pasteurization helps to shield the dirty farmer, and does not encourage cleaner methods of production. The farmer has the idea that as his milk is going to be pasteurized, it will be quite all right, and so milk plus filth is sent in to the wholesaler. Pasteurization also means extra handling of the milk, and there is the liability of infection of the milk after it has left the pasteurizing tank. Here

again the personal element comes into play in connection with the cleaning of the pipes, etc., through which the milk passes after leaving the pasteurizing tank, which, unless kept scrupulously clean, lead to further contamination.

In connection with the production of clean milk, it is very satisfying to see in *The Dairyman*, No. 5, Vol. XLIX, a paragraph, "Inter-county Clean Milk Competition," which reads :—

"In consultation with the Ministry of Agriculture and Fisheries, the British Dairy Farmers' Association have adopted a scheme for an Inter-County Milk Competition with the object of encouraging improved methods of milk production. The competition is open to all counties in England and Wales, and the 'Stapleton' Cup will be awarded to the county which, in the opinion of the judges, has made the greatest progress in clean milk production during the year immediately proceeding. The awards will be given mainly on the progress made under the schemes of technical assistance in clean milk education provided by the local education authorities and assisted by the Ministry of Agriculture."

A number of counties have for several years held clean milk competitions for farmers in their areas, and competitions in the best methods of milking. The Inter-County competition now established will take into account the results reached in the county clean milk and milkers' competitions for the year, the attendance of farmers at clean milk demonstrations, and the number of producers in the county who hold licences for certified Grade "A" (T.T.) and Grade "A" milk. This competition, together with the instruction provided, should prove a stimulus to farmers in the production of clean milk.

HOW THE VETERINARY PRACTITIONER CAN HELP THE PRODUCTION OF CLEAN MILK.

By E. J. BURNDRED, M.C., M.R.C.V.S., D.V.H.,
Veterinary Officer of Health to the Corporation of Blackburn.

So much has been written about the production of clean milk during the last few years, that it is almost impertinent for anyone to attempt to add to it, but it seems politic to continue to emphasise the necessity for clean methods of production. *I feel that the members of the Veterinary profession have missed a great opportunity in the past of not only educating their clients, but also showing the authorities how valuable their help may be. How often is it that the official has to tell the milk producer that his cowshed is badly lighted and insanitary? And what is worse, how many milk producing farms are there which are never visited by officials? All these places are visited by the general practitioner who is looked upon as a friend, not an enemy, and what*

wonderful opportunities he has of not only helping his client, but what is of infinitely more importance, helping the child life of this country.

There has been a great awakening amongst milk producers, but much yet remains to do, especially amongst the less educated in the industry, and that is work that the general practitioner can well do.

One is told so often that it is methods, not buildings that count, that, true as it is, there is great danger that such essentials as good light and easily-cleaned premises may be ignored.

The question of structural improvements, however, need not be discussed here, but rather the apparently small things which give such remarkable results.

STERILIZATION OF UTENSILS.—The usual method adopted at farms for the cleansing of utensils has become so time honoured, that it is sacrilege to suggest improvements to many people, but it is often possible to convince those who are reasonable by persuading them to vary their methods, and by means of bacterial counts of the milk produced under the varying conditions, actually show them the advantage of reform.

Two striking examples may be cited. At the first farm, structural improvements had been carried out; the cows' flanks and udders were clipped and clean; and covered milking pails were in use, but the sterilizing equipment was not in working order, so that the utensils had been washed in the ordinary way. A bacterial count of a sample of the milk gave 79,000. At the taking of a second sample of milk, no change in routine was made other than the sterilization of all utensils. The count was 355.

The results were similar at the second farm; the first count being 35,000. The farmer was advised to improvise a sterilizing equipment with the ordinary household wash boiler. The second count was 5,300.

Now that the new milk regulations have recognised the necessity for cleaning the flanks, udders and teats before milking, many producers are finding it difficult to comply, *and the necessity arises for someone whom they will believe to tell them that clipping and washing do not adversely affect the animal; and there is no one who could be that "someone" better than their popular veterinary adviser.*

In Lancashire we not only use all the available catchment area of our milking pails, but actually have an extra flange which could not have been better designed to catch all available dirt which might fall during the process of milking. It has, therefore, been extremely difficult to persuade the producers to use some form of covered pail, but the practice is spreading with extremely beneficial results.

One thing which has helped us greatly in Blackburn to secure improvement is the taking of samples of milk and examining for the

presence of visible dirt. The producer is notified when the disc shows contamination and may, if he so desires, see the specimen.

I had one of the most interesting examples of " seeing is believing " some time ago, when a producer, who had received a letter complaining of dirt in his milk, sent his wife to see me. She said that their milk was as clean as it could be produced. I showed her the disc which effectually subdued her, with the result that her lecture was given at home, instead of in my office.

The question of immediate cooling, and so keeping down the bacterial content is a serious one, as there are so many milk-producing areas badly served with pure water.

The present position is a national scandal and should be treated as such. The chief necessity, however, in connection with clean milk production, is education, not only of the producer and distributor, but also the consumer.

In Blackburn, particularly since the war, we have tried to carry this out in various ways.

We are this year having our sixth annual clean milk competition. Samples of milk are taken regularly and examined for sediment, fat and other solids, bacterial content and tuberculosis. Visits are made to the farms of the competitors, and score cards are filled in for methods and equipment.

Whenever health exhibitions are held in the town we have a " milk stall " showing, by means of models, etc., the value of milk as a food, and in addition, we usually devote part of the space to models, etc., suitable for the producer and dairyman. The Public are being taught at these exhibitions, and at addresses given at various times and places by the Medical Officer and myself, to demand clean milk; special advice being given with regard to the designated milks. Finally, producers are being encouraged to qualify for " Grade A " licences.

Much improvement has taken place. The producer, however, is a most conservative person. He dislikes lectures, *but I feel convinced that if the veterinary profession will only give him a lead, instead of pandering to his prejudices, a clean milk supply will be available in the near future with consequent benefit not only to the children, but also to the producer and his Veterinary Adviser.*

CLEAN MILK AND THE VETERINARY PRACTITIONER.

By D. H. ROBINSON, B.Sc.,

Head of the Biology Department, Harper Adams Agricultural College, Salop.

THE science of clean milk production is of such recent growth that both the medical and veterinary professions have been taken by

surprise. The ordinary medical practitioner and the practising veterinary surgeon have as yet very little idea of what the clean milk movement stands for, and how rapidly it is progressing.

With the medical aspect of the matter we are not here concerned. We can content ourselves by stating that it lies within the power of the general medical practitioner to enormously assist this movement, which aims at improving and safeguarding the milk supply of the nation. At present it must be confessed that medical men are in many cases acting as a brake upon progress. They are frequently prejudiced in favour of cooked, tinned, or dried milk, and do not seem to be aware of the high standards reached by present-day " graded " milks. It is no infrequent thing for a man who has set out to retail graded milk to be faced with great difficulties because doctors will not themselves buy it, and their example infects other people.

There can be no doubt that yet another subject will have to be added before long to the curricula of those studying for the veterinary profession. It is becoming increasingly important that veterinary surgeons should have a good knowledge of the principles underlying the production of clean milk and the groundwork of this should be taught in the college curriculum. *In future it will not be sufficient to pick up this knowledge in the course of actual practice as so many have to do just now. Systematic instruction will have to be given before qualification.*

I am aware that considerable time is already devoted to the study of buildings intended to house farm animals. Drainage, light, ventilation and cubic air space all receive attention. The modern tendency, however, is to lay more stress upon management than upon farm buildings where clean milk is concerned. The value and convenience of modern fittings in modern cow sheds are undoubted ; *but so many present-day cow sheds are not up to modern standards that the veterinary surgeon must, in his own interests, know how to get the best results from inferior materials. He must be in a position to give sound advice to the man who asks for assistance in improving the quality of his product.*

There are many small dairy farmers who, whilst not intending to take up graded milk, would like to make more certain of turning out a " clean " milk. For instance, there is a man who, when the cows are very dirty and wet, wipes down the flanks with an old sack before milking. The superior person smiles at him, but there is no reason to do so. Such æsthetic considerations are unknown in some districts. A man such as the above needs to be told how to keep his cows clean, how he can easily and cheaply sterilize his utensils and so on. Often he lives in a remote farm, out of the way of agricultural organisers, colleges, and so forth. *The local veterinary surgeon is*

frequently the only scientific man to come in contact with such people, and he can be of tremendous assistance if he has a good idea of what is necessary in the way of management for clean milk.

It needs to be clearly understood, however, that too much haste in this matter means slow progress. The veterinary profession need not bother itself much over those men who already sell " Grade A " or " Certified " milk. Such farmers are always able to get expert advice upon their difficulties because they know where to apply.

The profession can do far more good by attending closely to those dairy farmers who are unlikely to apply for licences for graded milk. But matters must not be rushed.

If a veterinary surgeon, bursting with enthusiasm after a short refresher course of instruction in clean milk methods, starts casting disparaging remarks upon buildings, standings, and general methods in vogue upon certain holdings, he is asking for trouble and doing the movement great harm. But there is no objection to giving a farmer tips which will at one and the same time save him work and make the milk cleaner. Nor is there any objection to telling him that free advice can be obtained in the matter by application to the local agricultural college, or to the agricultural organiser. *Most valuable missionary work can be carried out in this way, for the veterinary practitioner, if worth his salt, gains the confidence of his clients in a way denied to those whose positions in one way or another are official.*

I wonder how many veterinary surgeons know the address of the local agricultural organiser? or that every farmer in the country has the privilege (if he will only take the trouble to use it) of calling upon the staff of an institute or college for help in such matters as this of clean milk production? It is not to be expected that a veterinary surgeon with a large practice will have much time to spare for investigating methods of handling milk. *But it would be of incalculable value to those whose business it is to try to improve the milk supply of the country if the co-operation of the profession could be secured.*

At present I am not aware of any organisation by means of which College Staffs or County Organisers can come into contact with members of the practising veterinary profession. It would be of great mutual assistance could these workers meet together for the discussion of problems, particularly this one at present under review. As conditions are at present there must be many dozens of veterinary surgeons who are unaware of the existence even of agricultural colleges, and I am certain that as many more do not realise the scope of their activities. What is wanted is some form of liaison between the Veterinary Practitioner and the County Agricultural Staff. *The veterinary surgeon, in the course of his ordinary rounds, knows which*

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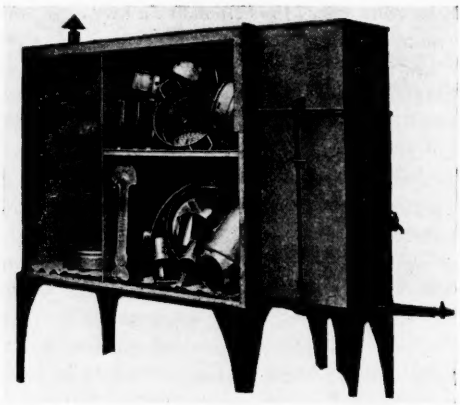
farmers are most in need of assistance. If incapable of giving that help himself, a word to the Organiser would soon be productive of results.

It is with regard to propaganda that the veterinary surgeon can be of such value. It is through propaganda first of all, followed by education, that the standard of milk sold in this country will be raised. In my opinion it is far better to endeavour to raise the *general* standard of all milk produced, than to concentrate upon a few producers of an exceptionally pure milk. Far better to have everyone producing "Grade A" milk than to have a few "Certified" producers, and the rest sending out inferior stuff. There ought to be more rejoicing over another recruit to the clean milk fold than over the reduction of a "Certified" producer's total bacterial count from 6,000 to 600.

THE IMPORTANCE OF STEAM IN THE CLEANSING OF UTENSILS.

By JOHN POLLARD, M.R.C.V.S., D.V.S.M. (Vict.),
Veterinary Inspector, Halifax.

In discussing the use of steam for the cleansing of utensils, one has to remember that dairy farmers are very much in the same position



Superheated Steam Sterilizer—Open, showing utensils.

to-day with regard to the germ theory as surgeons were in 1865, when Lord Lister revolutionised the practice of surgery as steam means revolutionising of old cherished ideas in dairying. Yet, as Maddick has stated, of all the factors which determine the bacteriological content of the milk the condition of the utensils is the most important.

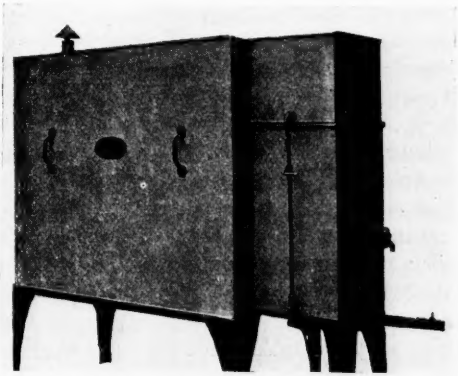
The following examples will illustrate :—

(1) A sample was taken from a source that was not promising, yet, much to my surprise, the report was good. On visiting the farm it was difficult to realise from the general condition of things, such as cows not being clean on hind quarters, how milk of such low bacterial count had been produced. The secret was the cleansing and care of utensils.

There is an adage that all is not gold that glitters, and one might add that all is not clean that appears so.

(2) In this case the producer took great pride in personal cleanliness, the cows and conditions were clean, yet a sample of milk taken for bacteriological examination resulted in a disappointing report, viz. .—

1,250,000 bacteria per c.c. Coli organisms+1/100 c.c.



Superheated Steam Sterilizer—Closed, and working.

It was presumed that the flaw was in the cleansing of utensils. A visit to the farm confirmed this, as the producer's wife was found to be wiping a churn inside and outside with a cloth. This will illustrate that endeavours made by the producer were rendered ineffectual by failure to appreciate the value of steam in the cleansing of the utensils.

(3) In another case a producer was advised to improve his methods, and even went to the extent of agreeing to boiling of the smaller utensils, and steaming of larger utensils over an improvised copper. Naturally, one would have expected a good report on his sample of milk, but owing to insufficient time being given to this operation, unfortunately such was not the case :—

Number of bacteria per c.c., 1,260,000. Coli organisms+1/100 c.c.

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Arrangements were made to sterilize all the utensils under supervision in a larger model than the one illustrated, with the following result :—

Number of bacteria per c.c., 20,000. Coli organism—1 c.c.

All appreciate the benefit of a cooling apparatus in rendering the milk less favourable to the multiplication of bacteria, but examples have occurred through lack of sterilization, of the cooler being an unmixed blessing and causing greater contamination than if the milk had been poured direct into the churn, and deposited in a well.

Utensils that have been thoroughly cleansed and subjected to steam do not require rinsing out with cold water, nor to " air." The lids can be affixed to churns without any fear of smell.

The advantage of thorough cleansing and sterilization of utensils is as a dairy farmer expressed to me, an easy mind—no complaints of sour milk. Clean milk without freedom from disease (tubercle bacilli) is futile.

Dairy herds in this district are small in number, and the model of the superheated steam sterilizer illustrated has been designed locally to meet their particular need.

The steam is generated by means of gas or a special oil stove, which means a great saving of labour over coal or other fuel. It is claimed that it is economical, as steam can be generated in 30 seconds, and boiling water drawn off for the washing of utensils.

The cabinet itself is so designed that it forms a suitable storage for the utensils after sterilization, until required.

As the late Lord Fisher wrote, " the luxuries of to-day are the necessities of to-morrow."

THE DISADVANTAGES OF THE BOTTLE SYSTEM OF MILK DISTRIBUTION.

By E. G. GIBBS-SMITH, M.D., D.P.H.,
Medical Officer of Health for Teddington, Middlesex.

The advantages of the bottle system of distributing milk have taken firm hold of the public mind. Closed bottles inevitably suggest safety and cleanliness, and short measure can be detected at a glance. Disadvantages have barely occurred to the general public ; but, in my opinion, they are so formidable that they entail the condemnation of the system as it works in most places.

It demands but little reflection to see that the bottle in commonest use is thoroughly unhygienic. The narrowness of the neck of the bottle makes it difficult to clean the inside. The groove round the bottom inside edge, occasioned by the convex shape of the base, is

a more serious objection, because it affords a place for the accumulation of congealed milk. But the worst defect is the groove constructed around the inside of the neck for the purpose of holding the disc in place. In this tiny hollow germs and dust inevitably collect. The method of sealing with a disc is bad in itself. The bottles are opened, in ninety-nine cases out of a hundred, by pressing in the disc with the finger and so letting into the milk whatever may have collected on the outside. The amount of dust which must accumulate when these bottles are left on the stairways of flats, at street doors, and in areas, is obvious, and I myself have seen milk being left at a house when the dust cart was at the door. In addition there is a grave risk of contamination by animals, male dogs especially.

The manner in which these bottles are left for hours outside houses is, of course, partly the fault of the customers. These people do not realise the danger of so doing, and in some districts the empty bottles (which may not be thoroughly sterilized before refilling) are thrown on the dust heap or left lying about in a dirty yard. People in poor neighbourhoods were not in the habit of throwing empty jugs on the rubbish heaps, even if they did not keep them as clean as they should.

It is very clear that the task of washing some hundreds of these bottles a day necessitates a special cleaning apparatus. Many small retailers cannot or will not afford the money for such a plant. Some time ago I visited a dairy where the cleansing was done by hand. No hot water was laid on to the premises, and the water, which had to be fetched some distance, was not, and could not be, hot enough to be effective. An inspection of some of these bottles, supposed to be clean, confirmed what was to be expected; the bottom edge of the insides contained quantities of congealed milk. Let us appreciate how infectious diseases may be spread in this way. Empty bottles may be collected from an infectious house, rinsed, refilled, and sold again. They are delivered on an apparently clean hand-cart, glittering with well-polished brass and with every outward sign of perfectly protected milk.

Moreover, the roundsman who delivers the milk is not always to be relied upon. I have seen a man refill a bottle in the street, from a can, and seal it with a disc from his pocket; the bottle probably being an empty collected earlier on the round. The milk was then delivered.

The great majority of people are now receiving milk which is far more liable to contamination than it ever was by the old method of distribution. Opinions would probably differ as to the advisability of giving up the use of bottles altogether. *It may be possible to use*

some sort of cardboard container, which could be used once only and then destroyed, as in the case of cream. This would eliminate the danger of infection from imperfectly sterilized bottles. The obvious objection to destructible containers is cost; but against this must be set off the expense of installing and maintaining a sterilizing plant, and the time and labour incurred in the continual process of washing.

If glass bottles continue to be used they should be of such a shape that they can be easily cleaned and there should be no grooves of any sort inside. They should be made with wide necks and bottoms like an ordinary glass tumbler; *and the covering should be a cap which fits completely over the top of the bottle, and opens outwards.* It is only fair to add that there are some bottles in use which do embody most of these suggestions, but they are employed only for specially graded milk, and their number is small.

In conclusion, whilst glass bottles are used, very strict bye-laws as to the cleaning, capping, and sterilizing should be made and rigidly enforced.

THE TREATMENT OF MILK IN SWEDEN.

By FREDERICK HOBDAY, C.M.G., F.R.C.V.S., F.R.S.E.,
Hon. Veterinary Surgeon to His Majesty the King, and formerly Professor of Hygiene in the Royal Veterinary College, London.

In a previous edition of The Veterinary Journal,* a report was rendered of a visit to Denmark last summer by the Fourth Veterinary Journal Party, and I myself, with four of my *confrères*, availed ourselves of the opportunity to continue the trip to Sweden; and in the above-mentioned article I promised to describe at a later date, and in more detail, what we saw and learnt on this occasion.

Sweden is a comparatively sparsely populated country; while the area is thrice that of England with Wales, or 173,000 square miles, the population is less than one-sixth, i.e., 35 as against 620 per square mile.

The Swedes are a healthy people; they are in fact reported to enjoy the longest term of life in any country. The English average for both sexes (which is comparatively high) in 1910 was 53·43 years, while Sweden ranked at 55·76 years. That there are very intimate relations between the dietary and the state of health is becoming every day more recognised, and it is well known that the use of white bread (because of the absence of non-digestible constituents) tends to decrease the activity of the bowels, and so is a powerful agent in causing constipation; and it is also known that milk, among our common foods, is especially rich in several of those most valuable

* The Veterinary Journal, October, 1926.

substances, the vitamines. Now the Swedish longevity at least is not inconsistent with the fact that the use of a certain type of dry, whole bread (which by the way has been introduced in U.S.A. too, and is becoming known there as "Swedish Health Bread") *and* milk for direct consumption plays a prominent part in the Swedish dietary. In fact the milk consumption there has always been the highest in any country.

Sweden is to a great extent a dairying country. According to the latest estimates, there are approximately 1,600,000 milch cows, which means one for every 3·3 inhabitants; in Great Britain and Ireland I think there is one cow for 6·6 per head of the people. The average milk yield in Sweden, being about 485 gallons, is inferior to that of Holland, Switzerland, and Denmark, but the Milk Recording Associations are doing much to increase the figure. In the year 1923 there were 558 of them, registering 8,265 herds with 177,286 cows, viz., more than one-tenth of the entire number of cows. The number has not as yet regained pre-war level, however, which was 786 recording societies. The work of these associations in ten years has effected a rise in the average yield of the herds registered, of approximately 10 per cent. In 1923 the milk yield within the associations averaged 709 gallons.

This means a large amount of milk, when compared with the figure for the population, and though there is a good deal of butter exported (chiefly to England and well known there under the "Rune" brand), there remains so much that the daily consumption of fluid milk ranks as high as a pint per head in the cities, and half as much more amongst the rural population. There is a great variety of the corresponding figures for different countries, but, any way, I have satisfied myself that the above figures are at least not put too high, and still they are twice as high as the highest figure I ever met with for England. Before the war, Sweden's figure was even very much higher, viz., by nearly 50 per cent. in the cities. There may be several reasons for this decrease in latter years; for one thing, during the war the milk supply became scarce and the prices exorbitant, thus forming a habit of abstemiousness which may still linger; further, wages and consequently the standard of living among the working classes have remained above pre-war level, and beef and beer have come to occupy a more prominent place in their dietary than the cheaper milk; thirdly, the birth rate has gone down enormously, so that among the tender ages there is far less than normal call for milk; and, fourthly (it may not be altogether unimportant), that milk is rather universally supposed to be conducive to plumpness, which does not exactly answer to the modern ideal. If the consumption of fluid milk has gone down somewhat, the consumption of milk products has risen, however; a propagation society

was formed a couple of years ago, and this work has prospered so well that it is estimated the consumption of cheese from slightly more than 5 lbs. (which is not much as compared with Switzerland's figure 18 lbs.) in a single year has risen by nearly 20 per cent.

As by far the largest part of the milk supply to the capital of Sweden, Stockholm, with some 450,000 inhabitants, is in the hands of a big co-operative organisation, the "Farmers' Milk Sales Organisation," popularly known by the name of "The Milk Central," or "M.C." Some words about its development and organisation may not be out of place.

It came into being in the year 1915, through the amalgamation of several existing large private enterprises, but it nevertheless is essentially a co-operative organisation. Dairy farmers only may apply for membership, and every member is required to hold a share amounting to three guineas per cow, only two-thirds of which is paid in, the other third being a liability only to be made use of in case of need. Interest on the amount paid in is restricted to five per cent.; the members are paid according to a fixed rate for the milk, and the profit is distributed in accordance with the quantities delivered.

At the end of the year 1915, there were in all 1,523 members with an average of 22 cows; nine years later the members counted 5,662, with an average of 12·6 cows.† The M.C. then owned not less than 119 dairies, and the daily amount of milk averaged 132,200 gallons. Out of this milk approximately 35,300 gallons are sold as market milk in the town of Stockholm, representing about 70 per cent. of the total supply of market milk there. The remainder is manufactured into butter and cheese; the cheese sales represent about 25 per cent. of the cheese consumed in Sweden.

Part of the milk for direct consumption is sold as certified; it is bottled, in a raw state, from T.T. cows, but it is an interesting fact that, far from increasing, in a few years the demand for this grade of milk has gone down by nearly two-thirds and at present represents only some 550 gallons daily, a very insignificant part of the whole supply. And yet the price is even lower than 2½d. a pint.

The main reason to account for this astounding fact can be but one, viz., that the other milk represents a perfectly safe, high-class product. The M.C. was the first in Scandinavia, if not in all Europe, to introduce the method of paying the milk according to quality. The quality is determined, partly according to the fat content, partly according to the dirt and germ content. A certain basic price is fixed for milk having a fat content of 3·3 to 3·4 per cent., which is con-

† NOTE.—I learn that on January 1st, 1927, the figures were 7,260 and 12·1 respectively.

sidered as normal. It might be mentioned in passing that Friesian cows are found mainly in the south of Sweden ; in the central parts of Sweden the breeds are mainly Swedish, Ayrshire, and some traces of Shorthorn blood, which accounts for the higher fat content. The legal standard is three per cent.

For milk containing less than 3·3 per cent. a certain deduction is made for each 0·1 per cent., and for each 0·1 above 3·4 per cent. a bonus is paid. Dirt and bacteria tests are, same as the tests for fat, made each week for each patron, and according to each of these tests the milk is classified into four grades, I to IV. There are no plate counts for bacteria in the regular run, but the simple and handy reductase (methylene-blue) test is used, which in latter years has come much in evidence in a good many other countries. Its originators were a Swedish and a Danish scientist, Barthel and Orla-Jensen, both of international repute. If the milk samples are not decolorised within 5½ hours, the milk attains the highest mark, I ; 2 to 5½ hours represent grade II ; 20 minutes to 2 hours, grade III, and decolorisation within less than 20 minutes, grade IV. The following points are allowed for each of the different grades, as well in the dirt as in the reductase test : I, 6 points ; II, 4 points ; III, 2 points ; IV, 0 points. This method of payment, coupled with a laudable educational work among the members, has worked nothing short of wonders. Five years ago the average number of points amounted to 7, whereas at present the average has risen to 10 points out of 12 possible. At present 8 points are even regarded as standard, so that there is a deduction made from the basic price for each ½ point below 8, and a bonus paid for each ½ point above 8 points.

The low temperature, 145°, holding process pasteurization is recognised as a means of rendering the milk perfectly safe for consumption, without altering its original composition, palatable qualities, or nutritive value ; all the milk is subject to it on arrival on the premises of the M.C., which are throughout fitted with the most up-to-date machinery. The milk is not bottled, and there is no peddling or delivering into the homes of the customers. It is delivered in bulk either to the shops of the M.C., whereof there are 158 in Stockholm alone, or to independent dealers, which draw their supply from the M.C. There are in all about 1,200 milk shops in Stockholm, and the legal requirements as to sanitation are rather stringent—the premises must be used only for the purpose, etc.

In this way the costs for the handling and the distribution of the milk can be kept on a low level, and the price actually paid by the customer for a high-class product is in fact less than 2d. a pint.

Another very interesting feature is the widespread use of mechanical milking in Sweden. I am told that the greater part of the milk handled by the M.C. is drawn by machines, which surely speaks well for their practicability and the quality of the produce; and, by the courtesy of the Directors of the Alfa-Laval Machine Milking Company, our party were enabled to see the actual working of the machine milkers upon some 15 farms where the cows are always milked in this way. As regards the universal use of milking machines, Sweden ranks second only to New Zealand, where some 60 per cent. of all the cows are reported to be milked by machinery; this Dominion, however, has the advantage of comparatively very large herds throughout, and in addition labour is very scarce and high. The figure for Sweden is estimated at 15 per cent. of all the cows, but then it must be taken into consideration that more than 50 per cent. of the Swedish farms average but 3·5 heads of cows, and that there are less than 35,000 farms averaging 8 cows or more.

Now, being aware of the fact that for many years the milking machines in England have enjoyed anything but an enviable reputation, and being moreover a veterinary surgeon by profession, I naturally wanted to avail myself of the opportunity to make a closer study of this matter. It seems that by far the majority of the milking plants have been installed in recent years, and mostly by a single firm, the "Separator" Company, of Stockholm. This firm was founded somewhat more than 40 years ago, for the sole purpose of manufacturing and marketing the first continuous centrifugal cream separator, which was at that time invented by the famous Swede, Dr. De Laval. It is well known how this invention has revolutionised dairying and it speaks well for the way in which this original make still retains the supremacy, that the original small company has grown to a world-wide concern, with affiliated or closely allied companies in practically every country; also that the number of Alfa-Laval separators in use is reputed to exceed that of all the other makes taken together. Through the courtesy of the Directors of this company, I—and my confrères—had the interesting experience of visiting a number of dairy farms, some small and some large, where these milking plants were in regular use, and studying this method of milking, particularly as to how it affected the cows. This, of course, is hardly the place for a technical description, and it is sufficient to say that the machines seemed to agree excellently with the cows (who as a rule stood contentedly chewing the cud), and that the machines seemed very easy to maintain in a clean condition and very easy to operate; the latter being especially due to an ingenious, though

simple, device which gives a central and perfectly automatic control (which I am given to understand is the main innovation in this type of machine), by means of which all the machines in the plant work in unison and with a perfect accuracy. I have also seen these machines in constant use in large dairies in Holland and through a study of the reports of some confrères of mine in other countries, who have had an opportunity of investigating and most thoroughly testing their value whilst in practical use, I have since been able to convince myself still further that the working of the machine is as physiologically correct as is well-nigh possible, and conducive to maintaining the milk yield on the highest level.

It seems that these machines are rather a recent line of the above-mentioned company's, but that in spite of this they are already working in most countries. The greater part of the Alfa-Laval milking machines are produced within the boundaries of the British Empire, viz., by the Canadian Laval Company, and I am told that not only cows, but also zebus and buffaloes are milked by these machines in British India.

Another feature of interest is that when the Swedish Company started marketing the milking machines, the average size of the herds milked mechanically was as high as 60 cows, whereas in but a few years the smaller dairy farmers have adopted this system and the average size of herd is now down as low as 24 (which, by the way, closely corresponds to the actual figure in America too), and that the percentage of milking machine plants sold for herds of 10 cows or less, which hardly amounted to seven per cent. in the year 1924, has already increased to more than 12 per cent. The use, therefore, of the machines is not restricted to the larger or middle-sized herds only; and as regards the quality of the produce, we are all aware that the New Zealand milk and butter ranks among the very best.

Now that the machinery itself has become simplified and the process of cleansing perfected the use of milking machines in England is steadily increasing; and they still further appeal to the agriculturalist and dairyman on the ground of their labour-saving properties. The former prejudice which existed some years ago may in many instances have been based on hard facts, but of course there is such a thing as "evolution" in milking machines as in other things; and those who have had experience of the value of the present-day modern up-to-date milking machines in the production of "clean milk" have no wish to return to the more troublesome and expensive method of hand milking.

THE MILK SUPPLY OF THE CITY OF COPENHAGEN.

AN ADDRESS BY PROFESSOR MØRKEBERG OF THE COPENHAGEN VETERINARY COLLEGE, THE MANAGING DIRECTOR OF THE COPENHAGEN CITY MILK DISTRIBUTING CENTRE, ON THE OCCASION OF THE VISIT OF THE FOURTH "VETERINARY JOURNAL" PARTY TO COPENHAGEN.

ON the place where this building now stands, there was built just 50 years ago the first dairy in Copenhagen where efforts were made to procure and supply to the inhabitants of the city, a really fresh, sound and wholesome milk. To do this, the herds which supplied the milk were placed under the inspection of qualified veterinary surgeons, and measures were taken to provide for the building and equipment of premises in the city where all the surroundings and utensils could be readily cleansed and kept clean, and the milk submitted to certain processes of cooling and cleansing. This dairy was named "The Copenhagen Milk Supply." Until the establishment of this company, the inhabitants of Copenhagen got their milk partly from cows standing in byres inside the boundaries of the town and partly from byres belonging to the local distilleries, which took the milk direct to the consumer; and, it frequently happened that a person could not purchase milk unless he also purchased spirit. Our town had then only 23,000 inhabitants, whilst now it has over 700,000. At the commencement, the dairy here only sold 2,000 kilos of milk per day, but as the town grew, the output had to be increased, and a number of important improvements were introduced. After a few years, the building became out of date, and it was decided to have it entirely rebuilt and reconstructed.

The new dairy, as you see it now, was only completed a year ago, and in this present building we have endeavoured to follow as far as possible all modern hygienic ideas and improvements. The hygienic control of the milk commences at the farms from which it is obtained. All cattle from which milk is obtained for this dairy are examined once a month by veterinary surgeons appointed by the company. These gentlemen have instructions to carefully examine all the cattle, and to report at once and take the necessary steps when any disease is found. Cows found to be suffering from tuberculosis are removed at once from the cow-house; whilst those suspected of this disease are at once isolated and their milk is not allowed to be sent with that of the others. In the case of other disease the influence of which might prove detrimental to the quality of the milk, the milk is kept back and the animals in question are, if necessary, either placed apart in the cow-house, or removed entirely. Milk sellers are bound to keep back the milk of any sick cow, even before it has been seen by a veterinary surgeon. In the event of contagious disease making its appearance amongst live-stock, or even if only

suspicion should arise that such a state exists, the milk purveyor has instructions to communicate at once with the dairy, and the milk is then kept back until the veterinary surgeon declares that all danger of using it has passed. The veterinary surgeon has also to examine the cows, and particularly their udders, in regard to cleanliness. He controls the cleanliness of the cow-houses and occasionally inspects the milking and the cooling of the milk. Finally, he examines the quality of the food, and he has to make a monthly report on the conditions he finds existing in the herds under his control.

The health of the persons coming in contact with the milk at the place of production is also reported upon, and every dairyman is bound to communicate with headquarters at once, in the event of any acute infectious disease arising in his employees or in their homes. He is likewise bound to send for a physician in any case where there is the slightest suspicion of an infectious disease, and he is compelled to keep back the milk until all danger of infection has passed. He is furthermore bound to exclude from his service any person who, on account of other disease, might convey infection to the milk.

Feeding, milking and handling of the milk at the place of production is carried out in accordance with strict rules. Everything used for feeding the cattle must be perfectly fresh. The cows are groomed daily, and the cow-houses are kept reasonably clean. The hairs of the udder and surrounding parts are clipped away in the autumn before the animals are stabled for winter. For the first three days after calving the milk is not permitted to be mixed with the dairy supply. The udders of the cows are carefully wiped and, if necessary, washed, before milking begins, and the milkers, who are clothed in clean gowns, must wash their hands carefully immediately before commencing.

From the milk pails, the milk is poured into vessels which are placed *outside* the cow-house, and the milk is poured through a Ulander filter, by means of which particles of dirt are kept back in a thin layer of wadding which is placed between two fine sieves. Having passed through this filter, the milk is immediately cooled by running over refrigerators which are kept cold by iced water. After the cooling process, by which the temperature of the milk is brought down to about 8° C., the milk is poured into clean cans which have been sterilized, and are provided by the dairy ; these cans being closed with close-fitting lids before being taken away. The full milk cans, each containing 50 litres, are kept in a cool place until they are taken off to the nearest railway station.

The dairy itself employs only healthy people, and should any of the employees be attacked by any illness, they are bound immediately

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to communicate with the physician of the company, who decides how long the worker in question has to refrain from service in the dairy. During their period of illness, the employees are paid full wages. In the event of any employee found to be suffering from some chronic infectious disease, such as tuberculosis, or from some infectious skin disease, or anything with discharging sores on the hands or face, he or she is excluded from the service of the dairy.

Samples of the milk are sent to the laboratory to be tested in regard to appearance, smell and taste, in regard to purity and fat contents (Gerber apparatus). Also, the fermentation test is regularly used and bacteriological examinations are made when more information is desired regarding the number and kind of bacteria.

The building itself consists of three stories; one where the milk is treated before it is bottled and where the cans are cleaned, and where butter is made; another part where the bottles brought in from the town are cleaned; and the third part includes the bottling room, in which the clean sterilized bottles are filled with milk. All the rooms are lofty and well ventilated, and the floor is made of material which is easily cleaned. The milk, as it comes from the train, is immediately taken to the top of the building where each can is lifted up and emptied into a large trough. By commencing at the top of the building, no pumping of the milk is needed. As it comes on to the top platform, the milk of every can is tasted and weighed, and then passed through a separator which only turns 600 to the minute, and thus only separates any possible dirt which may be in the milk, without altering the constitution of the milk itself. Children's milk does not pass through the cleaning separator, but goes through a special filter. The milk runs down to the cooling room on the first floor, or it passes through a pasteurizing apparatus where it is momentarily heated to 85° C. In the cooling room the milk passes over large refrigerators cooled by iced water, by which the milk is brought down to 2° C. From the refrigerators the milk passes through closed pipes into large tanks, the biggest of which can take about 3,000 litres. From these tanks, the milk passes into the bottling room on the ground floor. Entrance is forbidden into these two last rooms, except for those who have work to do there. In the bottling room the bottles come along on a rolling band to the filling apparatus, after which they are closed with paraffined pasteboard discs which are pressed to the neck of the bottle by means of a stamp.

They are again brought mechanically on a rolling band to the store-room where they are placed in cases and cooled with ice until the early morning, when they are loaded into the vehicles which distribute them about the town.

Practically everything is done by machinery, and neither the bottles nor the milk are touched any more than is necessary by the hands of the workers.

The different kinds of milk and cream which are disposed of are: raw milk, pasteurized milk, skimmed milk and butter milk; raw and pasteurized cream in different qualities, and a cream which is homogenised and sterilized. There are also different kinds of special and certified milk—ice milk, children's milk, and Jersey milk. The latter are from stocks which are certified free from tuberculosis and these have particular inspection twice a month. Tuberculin test takes place twice a year, and all reactors are immediately removed from the farm.

THE HYGIENE OF THE COW.

By G. MAYALL, M.R.C.V.S.,
Bolton.

How is it we see far fewer dirty horses than cows? The reasons seem obvious. The horse is exposed to the public gaze daily. One man attends one horse; the grooming of the horse daily has been held to be necessary. The fæces of the horse are more solid and less liable to soil, and the class of man associated with the horse is better taught and paid than the cowman. The cow, on the other hand, is not seen out every day by the public. One cowman attends several cows. Grooming a cow is generally thought to be unnecessary, or at any rate, it is more "honoured in the breach than the observance." The fæces of the cow are more liable to soil, and are swished about by the tail; and the type of man associated with the cow is seldom exhorted to groom his cows, is less proud of the appearance of his animals than the horseman, and the leisurely farmyard ways, after the milk has been sent off, fre quently remind one of the man who wants an easy job like laying a stair carpet in a bungalow. The argument that the necessary toilet of a cow producing clean milk needs too much time to accomplish will not hold water. If the udder, flanks or hindquarters of the cow be clipped at the outset, it is merely necessary to spend a minute or two on each cow before milking. Cleanliness will also be aided by clipping the long hairs on the tail and shortening the brush.

What are suitable methods to obtain cleanliness of the cows? In some cases the cows are scraped, washed with a wet brush, using plenty of water on flanks, tails and udders. Surplus water is wiped off with a cloth, and finally the udders and teats are washed and dried with a cloth used only for this purpose. The water is frequently changed, and udders and tails are kept clipped to facilitate cleansing. A boy carries out these important preliminaries, and works at least

two cows distant from the one being milked. The cows are milked while the washed parts are still damp.

This seems to be much like the plan adopted in places in the south and Midlands, where the weather all the year round is milder and more genial than it is further north.

About here there is some objection to using so much water about a cow's udder and quarters. The curry comb and dandy brush, the latter being lightly wet to keep down dust, are more frequently used locally. The udder and teats are cleansed with a clean damp cloth dipped in clean cold water, and in some cases the udders have been previously shaved.

Really we think there is no excuse for so many dirty hind ends of cows. The question of labour is not so serious, for three cowmen and a boy ought to be quite sufficient to deal satisfactorily with a herd of 40 or 50 cows. Proper arrangements of the stalls, standings and floor space, and judicious mucking out play a prominent part in the keeping of cows clean. Caked muck on cows can be removed by clipping and clogged tails cleansed with soda solution, washed and clipped.

When noticing the state of a cow that may be described as good, look at the condition of the flanks and udder. One need not always be present to see if the cows are regularly cleaned. The hair of the quarters will be free from manure, smooth, glossy, and shorter and thinner than in cows not regularly brushed. Skin débris and particles of dirt collect in the hollows at the root of the tail, and their presence points to indifferent cleaning, or its neglect.

Although the cow has been well cleaned, there may be fresh manure on the buttocks; the cow pressing her tail down during defecation, and moving it from side to side, and thus soiling them.

THE PRODUCTION OF MILK (CLEAN OR OTHERWISE) FROM THE PRODUCER'S POINT OF VIEW.

By WM. G. FORBES, M.R.C.V.S.,
Kilmarnock.

WHILE the production of milk of the variety known as "clean" has always been maintained on a fairly level standard in Scotland, due mainly to the naturally conscientious and cleanly habits of those engaged in the trade, there is no doubt that the observance of methodical methods recently introduced in connection with the attention given to cows, milkers, utensils and premises, has raised that standard generally, without, unfortunately, increasing the return to the producer for those additions to his labour.

Before any unduly critical opinion can be put forward the con-

ditions under which the material is produced and disposed of—in many cases those are adverse to the best intentions or interests of the producer—should be closely reviewed; and to do this fairly or exhaustively would require much greater space than is available for an article of this kind.

In the first place it must be admitted by the impartial observer that while "reform of methods" was in many cases desirable, the present-day regulations may be said to begin "at the wrong end of the business"—this on account of the fact that the producer has to accept the law as laid down, without seeing any chance to improve his own, already over-burdened position.

"Take the position at its face value." To produce milk the individual has to invest his capital in the stock, find the expenses of upkeep, stand the losses from depreciation and mortality, to say nothing of the slavish labour entailed (seven days a week—personal and paid for), and then accept a price for his product, which, unless he is also a retailer, works out like changing a shilling or worse, and yet has to stand the criticism and grumbling of the consumer who invariably pays top price. How many consumers realise what the difference between the price to the producer and consumer really is? Here it may be fairly claimed that few people are better fitted to estimate the difficulties of the milk-producer than veterinary surgeons who practise amongst dairy-farmers.

It might be suggested that the producers have themselves to blame for this condition of affairs, and while some form of co-operation or trade-unionism would certainly help, it would not entirely obviate the difficulty, as the question of "surplus milk" will always be a bogey, so long, as at present, the supply exceeds the demand. The various regulations and orders which are gradually coming into force will offer a remedy to a certain extent, for in many cases, through no fault of their own, but simply on account of premises not being up to standard, etc., many people are being driven out of the trade, and not a few wish that their circumstances would allow them out.

While bottled milk from graded herds is invaluable to those who can obtain it, there still remains a vast production to be accounted for, and, while the material must stand scrutiny in point of cleanliness and nutritive value, the producers who provide for the masses ought to be in a position to claim the right price for the right material.

In conclusion, it might be suggested that the huge increase, within recent years, in the importation of dried milk products, ought to be considered in the proper quarter, as those prove a serious menace to the milk-producers of this country in relation to the question of surplus milk.

TUBERCULOSIS AND MILK.*

By NATHAN RAW, C.M.G., M.D., J.P.

In the *British Medical Journal*, of 1903, I ventured to suggest that bovine bacilli conveyed by milk played an important part in causing tuberculosis in children. This has since been confirmed by many other workers, and is now accepted as a serious menace to child life.

The International Congress on Tuberculosis which was held in Washington in 1908, will always be remembered on account of the discussion which took place on the part played by the bovine bacillus in the production of tuberculosis in man. We were honoured on that occasion by the presence of the great master, Robert Koch : and those of us who took part in the secret session will never forget it. Up to that time Koch had not publicly admitted that bovine infections in man were possible, but he later modified his views, and we are all now agreed that an important amount of tuberculosis, especially in children, is directly conveyed from the dairy cow.

At that Conference I read a paper, entirely based on clinical and hospital observation, pointing out the possibility that surgical tuberculosis in children, such as enlarged lymph glands, mesenteric disease, bones and joints, were separate and distinct infections from those of Pulmonary tuberculosis, and might be caused by milk.

The brilliant pioneer work of our president, Thebold Smith, on the role of the bovine bacillus, stimulated many workers, myself included, to further investigations, and it is particularly fitting that 18 years afterwards in this city of Washington, Dr. Park should tell us of the immense reductions in infant mortality and suffering, as the result of their researches.

The incidence of bovine tuberculosis varies very greatly in different countries and depends upon the extent to which cattle are infected with tuberculosis and the amount of uncooked milk, butter, cheese and other dairy products consumed. In England and Scotland, dairy cows are very heavily affected with the result that surgical tuberculosis is very common in children.

In the light of our present knowledge we cannot say with certainty which particular strain of bacilli have caused the infection.

We are accustomed to recognise three types of tubercle bacilli :—

(1) Human ; (2) bovine ; (3) avian.

I feel convinced there are several intermediate strains of bacilli, which we cannot yet recognise with certainty, and it is not possible to say without bacteriological and animal tests to which group they

* A paper read before The International Conference on Tuberculosis, Washington, October 2nd, 1926.

belong from every lesion. For this reason, for the purpose of determining milk infections, clinical and hospital evidence is valuable.

Pulmonary tuberculosis is in a class by itself, and is practically always caused by the human type of bacillus, which also causes laryngitis, secondary intestinal ulceration and fistula.

It is rare for these cases to develop any other lesions.

On the other hand, bovine infections in the human rarely develop pulmonary lesions. In fact, they seem to be antagonistic to each other, and it is possible that a primary bovine infection, such as enlarged neck glands, may produce immunity against pulmonary tuberculosis for life.

Should this theory prove correct the beneficial effects of sterilization of tuberculous milk may be followed by diminished resistance to human infection in the form of pulmonary tuberculosis. In any case, it is imperative that the milk supply be pure and safe for children.

Avian bacilli, although considered to be non-pathogenic to man, may contaminate a milk supply with what effect we do not know. In Denmark the danger of infection of pigs by avian bacilli is so real, that legislation has been introduced forbidding chickens on the farm.

To sum up. In my opinion human bacilli produce pulmonary tuberculosis, tuberculous laryngitis, secondary intestinal ulceration, fistula-in-ano. Bovine bacilli produce (1) enlarged lymph glands, (2) abdominal tuberculosis, (3) lesions of bones and joints, (4) meningitis, (5) acute miliary tuberculosis, (6) lupus, and rarely-secondary extension to lungs.

These infections are antagonistic to each other, and human and bovine bacilli are rarely found in the body at the same time.

What are the Practical Measures to be taken against Bovine Infection?

1. Eradication of tuberculosis from dairy cows. 2. Pasteurization of all milk for human consumption. Eradication is for a long time impossible. Pasteurization is a safe and certain remedy. The results in several large cities where compulsory pasteurization is law, are truly wonderful, and have resulted in the saving of the lives of thousands of children every year; and have done away with endless pain and suffering with life-long deformity. I sincerely trust the splendid pioneer work in New York, and other American cities will soon be universal. At the same time it is imperative that every effort should be made to stamp out tuberculosis in dairy cattle.

It is estimated that in England about a million dairy cows are affected with tuberculosis. The cows with udder disease are, of course, the most dangerous. The compulsory seizure, isolation and

slaughter of these cows is a slow, laborious, and very costly procedure. The new Tuberculosis Order recently introduced in England will in time have a most beneficial effect in removing diseased cows from dairy herds, and so reducing the amount of bovine infection in our children.

In addition to this, the direct and indirect financial loss to stock breeders and farmers from tuberculosis is enormous.

The question of the possible immunization or vaccination of cattle against tuberculous infection is of supreme importance, and, as practically all cattle are born free of any tubercle—infection taking place after birth—the problem ought to admit of a solution.

I would like to lay before this Conference the results of my own work during the last 18 years, in attempting to produce immunity in animals against tuberculosis. In 1906 Professor Koch gave me in Berlin a pure culture on glycerine agar of human bacilli from a virulent case of pulmonary tuberculosis. Professor Calmette, of Lille, supplied me with a virulent bovine culture from the mesenteric glands of a cow, and Professor Bang, of Copenhagen, gave me a culture of avian bacilli from the liver of a chicken.

These cultures have been subcultured on glycerine potato and transferred to glycerine agar every month for 20 years in my laboratory, and the present growths represent the 241st generation.

At the end of 1914 I was afraid the work would be interrupted by the Great European War, but I took the cultures with me to France, and as I had a good laboratory in the hospital, I was able to continue the subculturing there during the next four years.

The growths are still profuse and true to type, but they are now completely non-tuberculogenic and non-pathogenic to animals.

Every year since 1906 I had injected these bacilli into animals with a view of testing their pathogenicity, and until the year 1913, that is the 84th generation, I noticed no change in their virulence. After that time attenuation became marked, and in a series of inoculations of these bacilli into animals in 1914, they were observed to be avirulent. These experiments, which have occupied 20 years, conclusively prove that virulent tubercle bacilli can be attenuated to such a degree as to be avirulent and non-pathogenic, even to highly susceptible animals. Some hundreds of animals have been inoculated for testing the powers of immunization of healthy animals, and with excellent results. For the purpose of immunizing calves, a vaccine was prepared from attenuated cultures of human bacilli. It is a bacillary emulsion of killed bacilli, and contains all the products of the bacillus.

Living bacilli are never used, as the bacilli are destroyed by heat before preparation.

For the purpose of immunizing calves, they should be separated from the mother at birth, and fed on healthy milk for a week, when the first dose of vaccine is given, followed in another week by the second dose. They then associate with the other animals. It is given hypodermically in the usual way, under the skin of the abdomen, with strict antiseptic precautions.

It is only applicable of course to healthy animals.

During the last four years over 600 calves in valuable pedigree herds, have been vaccinated by careful veterinary surgeons, and tuberculin tests at intervals of six months have so far been most satisfactory. The duration of immunity has been in 120 calves over three and a half years.

In my opinion we want to aim at producing an immunity in the animal against the amount of infection it is likely to encounter in ordinary life. It is almost impossible to immunize any animal against a lethal dose of virulent culture.

The problem of tuberculosis resolves itself into the question of immunity.

The protection of the community by some safe scientific method of active immunization is the only effective way by which this preventable scourge can be eradicated. Turning to the question of human immunity, the problem is much more difficult, as children are susceptible to both human and bovine infection. At the special request of the parents of a large tuberculosis colony to which I was attached, and where each father has pulmonary tuberculosis, I gave all the children, over a hundred in number, two doses of protective vaccine prepared from dead attenuated bovine bacilli with the object of protecting them from human infection. So far they appear to be healthy, but it will require at least 10 years of observation before we can give any definite opinion as to its efficacy. In conclusion, I am of the opinion that it is possible to immunize cattle against ordinary infection by using killed cultures of attenuated human tubercle bacilli, in precisely the same way that we can give immunity to man against ordinary infection of typhoid and paratyphoid by using dead cultures of typhoid bacilli.

Animals cannot withstand large doses of virulent bacilli as a test of immunity, and I cannot see that it is necessary to give them. Our aim is to protect animals and children against the *ordinary* infection they are likely to meet with in life, and not against a lethal laboratory dose of virulent bacilli. In my opinion it is not necessary for this purpose to use living organisms.

THE "VETERINARY JOURNAL" "CLEAN MILK" AND "HUMANE SLAUGHTERING" DEMONSTRATIONS.*

As a sequel to the visit of the fourth VETERINARY JOURNAL party, in September last, to Copenhagen and Stockholm, which was undertaken particularly with the idea of visiting and studying the methods adopted in those two cities for the supply of clean milk to the inhabitants, the fifth VETERINARY JOURNAL party was organised to study the same question as it is adapted for London.

The United Dairies Company were approached, and a most courteous invitation from the directors to visit their principal pasteurizing and distributing depot, in Streatham, was the result.

Some 50 members and students of the profession, accompanied by several medical men and others interested in the "Clean Milk" question, formed the party, which was arranged under the leadership of Professor Hobday, the editor of the VETERINARY JOURNAL.

Invitations were issued to, and accepted by, the President of the Royal College of Veterinary Surgeons (who, being unable to attend in person, was officially represented by Maj.-Gen. Sir John Moore, K.C.M.G., C.B., F.R.C.V.S.), the National Veterinary Medical Association, represented by the President, Professor G. H. Wooldridge, F.R.C.V.S., M.R.I.A., the *Lancet*, represented by the sub-editor, Dr. T. W. Fox, the *Veterinary Record*, represented by Lieut.-Col. T. Dunlop Young, O.B.E., M.R.C.V.S., D.V.S.M., member of the Editorial Committee.

The party assembled at Red Lion Square, where charabancs were provided to take them to Valley Road, Streatham, where the depot is situated. Upon arrival, the party were met by Mr. Tustin, the Company's technical adviser, and a little later, were received by Mr. Gordon Evans, the managing director.

After being split up into small groups, the party was shown, in detail, the processes which the milk passes through from arrival at the depot, until it is bottled ready for the consumer.

The party was then taken to the stables where 60 horses were housed and fed under ideal hygienic conditions; the stables themselves being fitted with the most modern improvements, including a method of grooming by vacuum cleaner. This, as might be expected, interested the general practitioners of the party.

By the kind invitation of the directors, the whole party was

* The Fifth VETERINARY JOURNAL Trip, Thursday, March 17th.

entertained to tea, and the speeches which followed, expressed appreciation of the welcome, and of the instructive afternoon the party had had.

The charabancs were again requisitioned, and the party were taken to the slaughter-house of Mr. Austin, in New Park Road, Brixton Hill, where they were given a demonstration of a machine invented by Mr. Harris Weinberg, for the humane slaughter of animals according to the Jewish method. As those who are acquainted with the slaughter of animals are well aware, the Jewish method requires that the throat shall be cut in a special way according to religious rites, by one of the priests, without the animal being previously stunned. For this, the bullock has to be cast on the ground and its head is extended, often with a certain amount of force by means of a crow-bar and chain, the poor beast showing very great evidence of terror and pain during the process. The process of throwing to the ground often results in a great deal of struggling, during which, on more than one occasion, an animal has hit its head on the floor with such violence as to break off one or more horns; and it is to obviate this that Mr. Weinberg, who is an orthodox Jew, has devoted a good many years of his life, with the result that he has now got a machine (the principle of which is excellent) which entirely obviates these objections. It is a kind of box or covered stall into which the animal is coaxed and fixed; after which the box suddenly revolves and the animal's head and neck are in the necessary position, without any violent efforts at forcing. After full explanation by Colonel Young, the Chief Meat Inspector for the City of London, a bullock was quietly driven into the pen and the process was demonstrated. The whole company was high in its praise, and considered that the machine fulfilled the purpose for which it is required. The R.S.P.C.A. have given the machine their approval and taken the matter in hand, so it is to be hoped that the Jewish Schechita Board will now consider it with favour, for adoption.

Reviews

The Fighting Forces, Vol. III, No. 4, January, 1927. A Quarterly Magazine for the Royal Navy, the Army, and the Royal Air Force. Edited by Lt.-Col. R. M. Raynsford, D.S.O. London: Gale & Polden. Price 5/-.

The last issue of this popular quarterly magazine contains much of general interest to veterinarians, and especially those who are in the

Army Service. Most of the articles are of sporting interest, and one which deals with expenses incurred in order to keep a hunter and have one's share of foxhunting will be eagerly read by all whose desire is to indulge in this luxury, but whose Army stipend is the sole source of paying for it.

The editorial columns have two paragraphs which will be noted at once by the officers of the Royal Army Veterinary Corps as being of vital interest to their future. One is on "Mechanization in the Army" and the other on "The Knell of the Horse." The latter strikes a particular gloomy note for the R.A.V.C.

One reads: "In the Regular Army outside Divisional Artilleries and the Horse Artillery, all batteries have been mechanized except a few horse-drawn 60 pounders. It would seem that the time is approaching if it has not arrived, when the artillery of divisions will follow suit, at least in part. The retention of the horse within divisions has been due to the necessity of a form of traction allowing of continuous movement at infantry pace. Already trials are in progress in mechanizing the first line transport of infantry." And at the end of the paragraph, "But if the change from muscle to mechanism is slow, it is sure, and the abolition of the time-honoured rank of Driver, R.A. is an omen of the passing of the horse."

Time alone will show, but experience in the mud and shell holes of the Great European War certainly demonstrated in a very marked manner that the horse and the mule played a part which could never have been filled by mechanical traction, however perfect the ingenuity of man might make it, and we do not agree that the time to chant the funeral dirge of the horse has yet arrived.

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